THE REPUBLIC OF UGANDA

Ministry of Lands, Housing and Urban Development

Uganda National Urban Climate Change Profile

Final Report

May 2018

With support of UNDP

Empowered lives.
Resilient nations.

This report has been prepared by Dr. Revocatus Twinomuhangi and is a product of UNDP and the Ministry of Lands, Housing and Urban Development.

The findings and conclusions expressed herein do not necessarily reflect the views of UNDP or the Government of Uganda.

Consultant: Revocatus Twinomuhangi

CONTENTS

LIST OF ABBREVIATIONS/ACRONYMS

AR5	Fifth Assessment Report
BAU	Business as Usual
CBD	Central Business District
CCD	Climate Change Department
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanisms
CFR	Central Forest Reserve
CO_2	Carbon dioxide
DDP	District Development Plan
GCM	Global Climate Models
GDP	Gross Domestic Product
GGDS	Green Growth Development Strategy for Uganda
GHG	Greenhouse Gas
GKMA	Greater Kampala Metropolitan Area
GoU	Government of Uganda
HIGS	Hazard, Infrastructure, Governance and Socio-economic Framework
IGAD	Intergovernmental Authority for Development
INDC	Intended National Determined Contributions to UNFCCC
IPCC	Intergovernmental Panel on Climate Change
ITCP	Integrated Territorial Climate Plan
KCCA	Kampala City Council
KIIDP	Kampala Institutional and Infrastructure Development Project
MDAs	Ministries, Departments and Agencies
MDGs	Millennium Development Goals
MDS	Municipal Development Strategy
MoFPED	Ministry of Finance Planning and Economic Development
MoLHUD	Ministry of Lands, Housing and Urban Development
MoLG	Ministry of Local Government
MWE	Ministry of Water and Environment
NAPA	National Adaptation Programmes of Action
NCCP	National Climate Change Policy
NDC	National Determined Contributions to UNFCCC
NDP	National Development Plan
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NGO	Non-governmental Organisations
NPA	National Planning Authority
NWSC	National Water and Sewerage Cooperation
OPM	Office of the Prime Minister
PRELNOR	Programme for the Restoration of Livelihoods in Northern Uganda
RCPs	Representative Concentration Pathways

REDD	Reduced Emissions from Deforestation and Degradation
SDGs	Sustainable Development Goals
TOR	Terms of Reference
UBOS	Uganda Bureau of Statistics
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNMA	Uganda National Meteorological Authority
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USMID	Uganda Support for Municipal Infrastructure Development
WB	World Bank
WHO	World Health Organisation

Acknowledgements

The national urban climate change profile for Uganda was prepared with support from UNDP Uganda under the leadership of the Ministry of Lands, Housing and Urban Development (MoLHUD) and the Office of the Prime Minister (OPM) - Department of Disaster Preparedness. Consultancy services were provided by Dr. Revocatus Twinomuhangi.

The national urban climate change profile is one of the outputs of the UNDP supported programme of the Government of Uganda entitled: "Community resilience to climate change and disaster risks in Uganda" that is being implemented by the Office of the Prime Minister.

There are far too many people to mention by name, and hopefully everyone who contributed is included in the lists of names annexed to this report (Annex 3), but special mention must be made of the UNDP Uganda - Environment, Climate and Disaster Resilience Team; Office of the Prime Minister (OPM) – Department of Disaster Preparedness, the Ministry of Lands, Hosing and Urban Development (MoLHUD); and the Municipalities and Town Councils visited who gave magnanimously their time to this evaluation. Special thanks go to Mr. Onesimum Muhwezi and Mr. Steven Goldfinch of UNDP Uganda, Ms. Catherine Ahimbisibwe of OPM, and Mr. Joseph Walter Pade the Commissioner, Urban Development MoLHUD for the coordination, overall guidance, direction and quality assurance of the entire evaluation process; the UNDP, OPM and MoLHUD team for their technical inputs to the study. Specailly thanks go to Mr. Denis Kidega, the project contact person at MoLHUD for the coordination and cooperation that enabled the study to become successful.

We thank the technical officers in the urban area visited for their technical inputs and for providing a platform for full participation. The views and information provided by project teams and stakeholders in the urban areas visited are also highly appreciated.

We sincerely and whole-heartedly appreciate the contributions made by all stakeholders.

Executive Summary

Background

This report on the National Urban Climate Change Profile for Uganda provides information on the current climate and projected climate for selected urban areas, assesses the vulnerabilities of Uganda's urban systems to climate variability and climate change, evaluates the climate change responses that are underway or planned and proposes how to enhance urban resilience to climate change. The study was conducted at the national level and selected urban centres that include: Kampala city and Greater Kampala Metropolitan Area (GKMA); 14 Municipalities that include Arua, Entebbe, Fort Portal, Gulu, Jinja, Kabale, Kamuli, Kasese, Lira, Masaka, Mbale, Mbarara, Mukono and Moroto; and six Town Councils that include Amudat, Kiruhura, Malaba, Mpondwe-Lhubiriha. Nakasongola and Paidha.

The profiling urban climate change is aimed at providing urban policy and decision makers at the national level and in local governments, as well as practitioners with evidence base on the vulnerabilities of urban systems to the current and future impacts of climate change. A further aim is to enhance the capacity of the national and local governments to promote climate compatible urban development i.e. building urban areas that are vibrant, inclusive, sustainable and resilient in a changing climate.

The climate profiling involved analysis of historical climate trends and projecting future climate and assessing climate change vulnerabilities and adaptations. Historical climate simulations were conducted by analysing historical data that spanned from 1975-2005 (30 years) of two climatic variables: rainfall and temperature. Projection of future climate used two Global Climate Models (GCMs) of EC-EARTH CGCM and NorESM1-M. Each GCM was downscaled using SMHI-RCA4 RCM results over the period 2021 to 2050 (30 years) for Representative Concentration Pathways (RCP) 4.5 and RCP 8.5. The Hazard, Infrastructure, Governance and Socio-economic (HIGS) framework was used to assess urban vulnerabilities to climate change mainly focusing: on the urban economy, infrastructures, environment and ecosystems, and community livelihoods and well-being. The assessments also covered the magnitude of barriers and opportunities to adaptation and green growth, and the ability and willingness of urban authorities and communities to build climate change resilience. Finally the report proposes the actions needed to strengthen climate resilient urban development and green cities in Uganda. Although the main focus this report is climate change, the study took a broader view and does not consider climate change in isolation. It takes into consideration the linkages between urbanisation, climate change and sustainable development that are central to building the resilience of urban systems to climate change.

Support for the climate change profiling was provided by UNDP to the Government of Uganda through the Office of the Prime Minister (OPM) – Department of Disaster Preparedness and the Ministry of Lands, Housing and Urban Development (MoLHUD

Climate change projections

Like the rest of Uganda, the climate of urban areas is changing and this could heighten climate risks in urban areas. Uganda's climate change profiles produced by USAID (2013) and Ministry of Water and Environment/Climate and Development and Knowledge Networks (CDKN) in 2015 indicate that i) temperatures will rise, causing higher evaporation and reduced water availability, (ii) rainfall will be highly variable, and (iii) droughts and rainfall extremes will increase and become more severe. This is also true for Uganda urban areas. Mean annual temperature is projected to increase in all the selected urban centres with RCP 4.5 giving incremental values of between 0.6

to 0.9°C for the 2020s and RCP 8.5 giving values of 0.8 to 1°C compared to the baseline climate of 1975-2005. Kabale has the highest increment in annual temperature of 0.9°C under RCP4.5, while Moroto has the highest increase of 1°C under RCP 8.5 for the 2020s decade. An average increase of 0.2°C is observed in the projections per decade in most of the towns in both RCP 4.5 and RCP 8.5 with highest projections for Kabale reaching 1.3°C under RCP 4.5 and Moroto reaching 1.5°C under RCP 8.5 by the 2040s.

Unlike temperature, mean annual rainfall projections do not show a clear trend of either increasing or decreasing in the future period considered. Most urban centres especially in the Eastern region show slight increases in total annual rainfall of between 5% and 16% for the 2020s period under RCP 4.5. Lira, Arua and Nakasongola show slightly reduced rainfall of between 1 and 3%. Under RCP 8.5 most of the urban centres show decreasing annual rainfall apart from Mbale and Malaba which show a slightly increase in annual rainfall of about 2% in the 2020s. The decades of 2030s and 2040s do not show a particular trend in rainfall with both decrease and increase seen in the projections under both scenarios.

Impacts of climate change on urban development

Climate change impacts pose urban development challenges because rainfall and temperature impact on every sector of the urban economy and the livelihoods of urban residents. The urban development prospects will not be achieved, unless the impacts of climate change are mitigated. The projected increase in temperatures in the future will increase evaporation transpiration across the country that will reduce soil moisture, water table and available surface water. These will affect will affect agriculture, and food and water availability for the urban areas. There is also a likelihood of more hot days, hot nights and hotter days, and fewer cold days and cold nights in the future. The most significant climate change impact on urban areas will be increased variability in rainfall, with more frequent and intense rainfall extremes that result into flooding in most urban areas in Uganda. Flooding will destroy/disrupt infrastructure: housing, roads, bridges, drainage systems, water supply and energy supply, affecting the functioning of the urban economy and the livelihoods of urban residents. Variability in rainfall trends/patterns, more especially increased occurrence of droughts, will adversely affect (urban and peri-urban agriculture and agricultural production in the hinterland) resulting in reduced food supply and rising food prices. The urban poor who cannot afford the rising food prices will be affected most. Droughts coupled with extreme temperatures will also adversely affect urban water supply, water availability for generation of hydro-electricity and availability of biomass energy.

Vulnerabilities of urban systems to climate change

Uganda's urban systems are highly vulnerable to the current and future climate risks due to high exposure and sensitivities of the urban economy, infrastructures and ecosystems, and inadequate capacities of urban authorities and populations to adapt to the impacts of climate change. Understanding vulnerability is a vital part of climate change adaptation planning. Urban climate change vulnerabilities are heightened by the rapid urbanisation and urban sprawl, inadequate physical planning and development control, the poor state of urban infrastructure and services, degradation of natural assets and ecosystems and the high urban poverty which undermine building resilience. The weak climate change information and knowledge base, and inadequate institutional framework for climate risk management also exacerbate vulnerably. A sectoral approach was used in the dimensions of vulnerability and adaptation.

Energy vulnerabilities: ***Access to reliable and affordable energy is central to urban economic growth and the achievement of sustainable urban development. Most of the urban infrastructure,***

activities, services and livelihoods depend on energy supply but Uganda's supply is highly vulnerable to climate risks. In Uganda, hydropower is the main source of electricity to Uganda's urban areas but it requires significant amounts of water, which makes it highly vulnerable to climate change impacts. The projected increase in temperature and variability (reduction) of rainfall indicates a possibility that Uganda's hydropower potential will decrease. Urban systems will be affected most because of the concentration of economic activity and energy demand in urban areas. Extreme weather events (rainfall storms, floods etc.) will disrupt energy supply (power plants, transmission lines and distribution power lines) resulting in power cuts and higher energy prices. Heavy rains and flooding make road and rail transportation inaccessible indirectly affecting fuel supply that is brought into the country by train from the coast and distributed by trucks. The predicted rise in temperatures and the urban heat island effect are likely to increase demand for electricity for indoor cooling, further increasing energy vulnerabilities. The high dependence on traditional biomass (charcoal and firewood for cooking) is causing widespread deforestation and land degradation across the country and charcoal becoming increasingly scarce and expensive. A huge deficit of biomass is expected in the 2020s and beyond. Thus the increasing demand for charcoal is not sustainable, and a solution is urgently needed. A major driver of vulnerability of urban energy services is that energy issues are centralized at national level and urban authorities have no control over the operation of energy services consumed in their territories. However, energy supply challenges affect the operation of urban authorities and the urban economy, as well as the daily life of inhabitants. With urban authorities charged with responsibility of physical planning and landscape policy, they should play an increasing role in energy planning and integration of energy supply in physical energy planning.

Transport and mobility vulnerabilities: ***Efficient, reliable and affordable transport plays a major role in promoting urban economic growth and facilitates the growth and development of all other sectors of the economy. However, Uganda's transport is vulnerable to climate risks that damage transport infrastructures and disrupt mobility.*** Urban centres have high population densities and mixed landuse: industrial, residential and commercial buildings connected through transport networks/systems. Uganda's urban transport system is dominated by road transport, but most of the roads are unpaved i.e. only 20% of the urban road network is paved. The few paved roads have potholes and required rehabilitation and maintenance. The roads and bridges are strongly affected by floods, storms and landslides. In particular, flooding affects the safety, efficiency, cost effectiveness and punctuality of transport. The poor accessibility and connectivity affects not only the urban economy but also all sectors of the Uganda's economy. In addition, transport is a driver of climate change through vehicular GHG emissions. With the high levels of congestion on the road network, the transport sector accounts for 67% of the direct GHG emissions from the energy sector and for 3% of Uganda's GHG emissions. Another main vulnerability of the transport sector is that it is highly exposed to increase in fuel prices, and currently all the oil used in Uganda is imported.

Vulnerabilities of housing and the built-up environment: ***Housing is a basic human need and is one of the indicators of a person's standard of living. In Uganda's urban areas unplanned settlements, and most of them in high flood risk areas, are on the rise increasing the vulnerability of housing and the built-up environment to climate risks and disasters.*** In Uganda housing provision has been left largely to private sector, which has focused more on the needs of the high and middle-income earners leaving the housing for low-income earners and the poor to be catered for by the informal sector. The foregoing, coupled with inadequate physical planning and urban sprawl, has led to spontaneous growth of informal settlements and slums that are mainly inhabited by the urban poor. The slums are situated mainly in high flood risk locations and lack the requisite infrastructure and services to withstand the effects of climate change. When floods occur some of

the buildings collapse or become uninhabitable. Another major source of vulnerability is lack of climate proofed buildings/facilities construction and renovation standards at the national and local levels. Bio-climatic principles and guidelines are thus needed to guide consideration of the climate and environment components around the future buildings (eco-buildings). For example, at the plot level it is possible to recover rainwater, to produce energy, to treat some wastes or wastewater, to reduce run-off, to use nature/vegetation as a component of the thermal regulation of buildings, and as a noise prevention component. A lot can be done at the local level through landscaping policy, and at the plot level (standards, eco-neighbourhood) to reduce urban sprawl and improve the design and construction of resilient buildings.

Water supply and sanitation vulnerabilities: ***Although Uganda is well endowed with fresh water resources; water availability is closely tied to the prevailing climate. The degradation of water resources has reached critical levels and is heightening climate risks.*** The country's lakes are mainly fed by rivers, which flow either from glaciers and ground water resources. The impacts of a changing climate (droughts, storm water, and floods) are already causing stress on water resources, and the projected future climate will amplify stress on water availability and water quality, which will significantly affect the urban population, economy and environment. The rapidly growing population and urbanization will increase the future demand for water but the predicted impacts of climate change (especially droughts) will reduce water availability. The predicted decrease in rainfall amount in the Lake Victoria region will not only reduce water availability in Lake Victoria but will also result in increased water treatment costs, resulting in reduced water supply and high water tariffs. Kampala and Jinja are highly affected because their fresh water supply is drawn directly from Lake Victoria. Most urban water sources are exposed to contamination resulting from floods and run-off or pollution from various sources. Land degradation arising from increased deforestation; encroachment of wetlands and cultivation on steep slopes and riverbanks is increasing soil erosion and run-off, which result in siltation and contamination of water sources. Poor solid waste management practices, poor sanitation and discharge of industrial pollutants in water also compromises water quality, and a case in point is Lake Victoria. With the predicted climate (increased intensity of rainfall), the impacts of flooding on water in the future will be severe but more importantly they are likely to be more indirect, through increased cost to treat water, than direct, through the damage of the infrastructure. Another vulnerability is that the mandate for urban water supply is managed at national level, by the National Water and Sewerage Corporation (NWSC), and not by the urban authorities. This in itself is a driver of vulnerability because NWSC is not unable to cover the entire towns with piped water and alternative sources of water have to be sought: including boreholes, protected and unprotected springs, streams, rivers, swamps and wetlands; and yet the urban authorities cannot engage in water supply or regulation within the current legal framework. Moreover, the water connection costs and tariffs are high and the poor communities indicate that they cannot afford them.

Regarding sanitation, the majority of urban households that used pit latrines (73.9%), as compared to flush toilets (7.6%) while 2% do not use any toilet facilities. The NWSC is the principal provider of sewerage services in the large urban centres of Uganda, but main sewer network coverage is only 8% in the towns that are served by the NWSC. These sanitation conditions increase the level of water contamination during floods and heighten the vulnerability of urban areas. In Kampala city most the urban poor settlements are in flood prone areas that have high water tables. During heavy rainfall and floods, the resultant overflow of human waste increases the population's vulnerability to poor health and water borne diseases like cholera, typhoid and dysentery. These disease epidemics are reported to be increasing during periods of heavy rains. In the case of water stress, less water implies increased health risks of diseases related to dry conditions.

Solid waste management: ***Uganda's urban centres are faced with poor solid waste management that comprises public health, urban beauty and is a driver to flooding. The rapid urbanisation means increased waste generation that requires climate smart waste management solutions.*** Solid waste management is a decentralised service, delivered by local governments/urban authorities. Urban areas are already grappling with the challenges of solid waste management, and the concern is waste collection that is very expensive requiring large fleets of vehicles, fuel supply and maintenance of vehicles and yet municipalities have small budgets. Another concern is the energy efficiency of vehicles. Most towns are unable to collect more than 50% of the waste generated, and the waste is mainly composed organic waste (>80%) that can be composted, or converted into energy. Open burning of waste, open dumping, and illegal dumping on roadsides and drainage channels are practiced in all urban centres. The major climate change vulnerability related to solid waste management is flooding. The waste dumped on roadsides and in drainage channels is not only a driver to flooding during rains, but it also contaminates water. Another vulnerability is related to transport because road infrastructures are flooded during rains and waste collection cannot be done. Landfills can also be flooded and are also exposed to potential fires and to methane emissions. The waste sector is one of the major emitters of GHG emissions (methane) in Uganda. For example, the emissions from the waste sector increased by 71.9% between 1994 and to 2005, and by 38.0% between 2000 and 2005. However, the capture of the methane from the landfill could be a huge source of revenue and jobs and a way to significantly reduce the contribution of the waste sector to urban GHG emissions. Mitigating GHG emissions and waste to energy recovery should be prioritized in urban waste management. Waste should not be looked only at as a problem but as a potential or a resource, and waste minimisation approaches (recovery, reuse and recycling) can foster new business development, job creation and poverty reduction.

Vulnerabilities of the urban economy: ***The vulnerability of an economy to the impacts of climate change depends on the structure of the economy itself. Most urban economic activities are vulnerable to climate risks, and yet urban areas contribute significantly to Uganda's GDP.*** **When urban economies are affected by the impacts of climate change, the hinterlands' and national economies are also affected.** Heat waves, drought and floods affect the urban economy and the economies of surrounding regions in various ways. The decline of urban and peri-urban agriculture and agricultural production in the hinterlands due climate change impacts affects urban food supply and the supply of ram materials for agro-processing industries. The decline in forestry yields, loss of biodiversity and ecosystems, deterioration of working conditions in offices, deterioration of health conditions of the most vulnerable people, the damages to infrastructure preventing movement of people and goods, loss of attractiveness of tourism destinations, deterioration of water quality, unavailability of appropriate trade areas, loss of time-money due to traffic jams, disruptions in energy supply and reduced fishing potentials caused by climate risks and disasters have a significant impact on the functioning of the urban economies. Malfunctional urban economies affected hinterlands, national and international economies. For example, considering Kampala's economy and its influence on the country and the neighbouring countries (South Sudan, Rwanda, Burundi and Eastern DRC), even the outside economies are affected by the impacts of climate change on Kampala. Integrating climate resilience in urban development is crucial for making the urban economy more viable and promoting local economic development. Resilient urban economies also enhance attractiveness of cities and foster innovations.

Social vulnerabilities: ***Health and education are basic human rights and are central to socio-economic transformation of Uganda. The main components of health – like water availability (clean water), food availability and diseases prevalence are climate sensitive. Education is affected by climate risks but is also central to climate change action.*** The projected increase in temperatures,

droughts, heavy rainfall events and floods is likely to exacerbate diseases occurrences and other health-related challenges. Increased temperatures and increased is likely to result in a higher burden of malaria. Malaria epidemics are reported to have increased in areas originally considered malaria-free zones in the south-western of Uganda (Kabale). With the predicted climate change and population increase, the costs associated with malaria could double by 2050. Increased warming and flooding are likely to increase the prevalence and outbreaks of water borne diseases like schistosomiasis, cholera, dysentery, diarrhoea and typhoid. The wide spread use of pit latrines in urban areas increases public health vulnerabilities. The vulnerabilities of agricultural to climate change also expose human health i.e. crop failure results into food insecurity, hunger and malnutrition that further erode resilience. Another urban health concern is air quality resulting from air pollution. Air quality is more related to the energy use, especially combustion of firewood, charcoal and diesel, which emit particles in the air that lead to respiratory illnesses for human beings. The process of addressing climate change should incorporate air quality. It is crucial to develop air quality monitoring systems in urban areas, promote clean cooking, heating and lighting technologies and fuels, and above all promote climate change mitigation and green growth.

Climate change has a direct and indirect impact on education. Extreme climate events that lead to floods, landslides and fires have a direct impact on education facilities and on the quality of education. For example climate disaster can damage to schools. The impact of climate change on the health of teachers and students affect the learning environment. The climate impacts on transport affect movement and access to schools. Learning requires energy for lighting and running equipment and the impacts of climate change on energy supply indirectly affect the quality of education. Moreover, the impacts of climate change on agriculture affects the quality of education i.e. food and nutritional security are important for learning as they affect the health of learners and their ability to concentrate. But education is also critical in addressing climate change. Increasing environmental and climate change awareness through education is very important in building resilience. Not only does education provide information on climate change risks and disasters and how to adapt, but it also builds skills to better understand the information provided and to seek resources to implement climate solutions. Thus, urban authorities need to make critical investments in in educating and skilling their workforce to address climate change in delivery of urban services.

Vulnerabilities of ecosystems, environment and natural assets: ***Human societies derive many essential goods and services from natural ecosystems. Healthy ecosystems also play an important role in building the resilience of communities to the impacts from climate extremes and disasters and are also valuable stores of carbon. However, the ecosystems and natural assets are vulnerable to degradation and extreme climatic conditions.*** In Uganda, population growth and rapid urbanisation are already exerting increased pressure on ecosystems through conversions of wetlands and forests. Ecosystem degradation undermines the ecosystem protection function against natural hazards and disasters, including those related to climate change (floods). Forests and wetlands are important assets in the natural capture of carbon and mitigating GHG emissions. A reduction in forest and wetland cover can have significant negative impacts in terms of increased GHG emissions and reduced delivery of ecosystem services. Currently, 33% of Uganda's GHG emissions are from Landuse, Landuse Change and Forestry (LULUCF). During stakeholder consultations in the selected urban areas, poor management of watersheds, encroachment on natural assets like swamps, green belts and open spaces for construction, quarrying and bricklaying, and forests mainly for charcoal were considered as main threats to the urban ecosystems. Some urban areas are in the process of degazetting Central Forest Reserves (CFRs) for urban expansion i.e Barifa CFR in Arua Municipality, one in Entebbe Municipality, and Loroo CFR in Gulu Municipality. It is

essential to foster tree growing in urban and peri-urban to increase aesthetic and environmental values, provide wood products and provide opportunities for environmental education. Restoration of degraded ecosystems, especially wetlands is essential for flood management and delivery of essential ecosystem services. Integrating forest management in urban planning provides important entry-points for ensuring establishment and management of forest resources and other ecosystems.

Climate information and early warnings: ***Policy and decision makers and the wider public need reliable, accessible, and trustworthy information about climate and how this climate might change in future, if they are to plan and appropriately respond its impacts. However, Uganda (and its urban areas) is still constrained when it comes to delivering quality climate data, information and knowledge.*** The inadequate coverage of the meteorological network, human resource challenges and inadequate systems hinder ability to forecast weather, and to monitor, detect and predict climate change. Most urban areas do not have weather observation stations and have not developed early warning and disaster preparedness systems. Limitations on climate data, information and knowledge continue to constrain the make urban authorities' ability to manage or respond to climate risks and disasters. Climate information, education and communication need to be protected and linked into planning and early warning.

Managing climate risks to increasing urban resilience

Uganda's National Climate Change Policy (NCCP) seeks to promote urban planning and the development of resilient human that are robust enough to withstand climate change related risks and hazards. The World Bank (2011a) proposes that climate smart development can be achieved by adapting and mitigating risk selecting interventions from the **"three I's:** ***Information, Institutions and Infrastructure*****.** This approach can be applied to urban climate change action. **Urban areas need robust investments that can help turn climate risks into opportunities for urban growth and poverty reduction, where the benefits outweigh the costs of inaction.** For example, investments in green energy and sustainable urban transport systems can deliver multiple benefits: increase energy security, improve mobility, increase investments, create jobs, and improve incomes, and improve health and welfare while at the same time building climate resilience. Some examples of robust investments in urban areas can include clean water supply, resilient transport networks, renewable energy, forest and wetland conservation, improved health and education services, among others.

Information responses

For any urban territory to address climate change, its necessary to have a better knowledge of the climate change risks and hazards as well as the vulnerabilities and appropriate adaptation actions for the urban territory. It is thus essential to:

- Strengthen climate data collection, assessment and information, education and communications and link them into physical planning and urban development.
- Improve in weather forecasts and real-time decision support systems for operational and flood management to enable better management of floods and droughts.
- Put in place and strengthen urban climate early warning and disaster preparedness systems.
- Collate knowledge base on climate variability and change, impacts, vulnerability, and adaptation options related to urban systems.
- Build partnerships between the scientific and development communities. This is essential to ensure both that the latest scientific advances are reflected in urban development programmes,

and the scientific questions explored are shaped by urban development needs and decisions.

- Develop an urban climate and meteo-information system to inform and sensitize the urban population on climate risks and hazards like storms, floods or droughts risks will go a long way to build climate resilience and enhancing urban economies.

Institutional Responses

Although Uganda has put in place an elaborate national policy and institutional framework to address climate change, more effort is needed at the local level, specifically for urban authorities. Addressing climate change at the local level is greatly constrained by policy and institutional gaps. Apart from Kampala city, no other urban authority has a standalone climate change strategy/action plan to guide climate change response. Most urban areas have not yet adequately incorporated climate change in their urban development plans.

Currently the EU is supporting KCCA to implement a climate change project entitled *'Kampala Climate Change Action Strategy: Developing and sharing the low carbon and climate resilient Kampala'.* The project assistance is for supporting KCCA to implement its climate change action plan but in addition, the project is also building the capacity of some municipalities and urban centres in GKMA to develop and implement their own Sustainable Energy and Climate Change Action Plans (SEACAPs). The project is being implemented in collaboration with Entebbe, Kasese and Mukono Municipalities.

A lot can be done to improve the urban institutional effectiveness to address climate change in Uganda, and the following are proposed:

i. Strengthen the technical capacity of urban authorities to address climate change. This should start with training key technical staff in climate change. It will also be essential to raise climate change awareness among the political leaders and decision-makers. This will help to pitch climate change at higher level in the urban planning and decision-making processes.

ii. Establish an institution/office to spear head and coordinate climate change response in the urban authorities. Since climate change is a crosscutting issue that needs to be integrated in all plans and budgets, it requires a strong institutional framework for coordination and enhancing collaborations between the different departments and sectors. Establishing a climate change institutional framework will also help to build on the complementarities between the different department and interventions in the urban authorities.

iii. Uganda is in the process of developing a National Physical Development Plan. This is an opportunity to ensure that climate change concerns are integrated in the country's physical planning and development control and then be translated into climate proofed physical development plans within municipalities and town councils.

iv. Develop specific or standalone climate change strategies/action plans for urban authorities. The elaboration of urban climate change action plans should be highly participatory involving detailed vulnerability assessments and prioritization of actions/options specific to the urban territories, and these actions should cut across the adaptation and mitigation divide. The prioritized responses should be designed in a manner that will deliver adaptation-mitigation co-benefits and triple wins i.e. fostering urban development, climate change resilience and low carbon development.

v. Integrate/mainstream climate change in Municipal Development Strategies, 5-Yaer Development

Plans, Physical Development Plans, and other sector specific plans and programmes. In particular the target should be on urban water and sanitation, energy, transport, environment and ecosystem management, waste management, health, education.

vi. Revise/review building design codes and standards to address climate change risks (eco-buildings).

vii. Mobilize climate change finance. This can be through budgeting, but also accessing external climate finance. Importantly, the project development capacity of urban authorities should be enhanced to enable them develop and implement bankable projects. Without climate finance urban authority will not be able to engage in climate action.

viii. Build strategic partnerships with national and local level institutions as well as intercity (urban to urban) collaborations. Strategic partnerships with NGOs, private sector, universities and research institutions are very essential for climate change training, research and innovations, planning, mobilizing climate finance and implementation of appropriate climate smart technologies.

Infrastructure responses

A lot of discussion in this report centres on the poor state of urban infrastructure and utilities, as well as on environment and ecosystem degradation that makes urban areas less resilient to the impacts of climate change and extreme weather events: There is thus need for climate resilient urban infrastructure and ecosystems, and the following interventions are necessary:

- Critical investments in water infrastructure are needed to ensure water security that takes into account a changing climate in the future: from rainwater harvesting to large water storage recognizing that water availability and water quality require an ecosystem based approach that involves water catchment protection and ecosystem management extending beyond the urban territories. Urban authorities should lead by example and install water storage/ harvesting facilities. Institutions and public buildings can follow before rolling out the initiative to households.

Investments in renewable energy installations and energy efficiency at household and institutional levels to ensure energy access, energy

1. INTRODUCTION

Urbanization and climate change have been recognized as emerging challenges in Uganda that if not adequately addressed, could undermine the country's development path (Government of Uganda, 2010; Government of Uganda, 2015). Although Uganda's urban population is still relatively small (21%), the country is urbanizing rapidly. The country's annual urban growth rate is 5.2% far higher than the annual population growth rate (3%) (Government of Uganda, 2016a; UN-Habitat, 2016b). It is projected that more than 50% of Uganda's population could be urban within the next 50 years. This high urban growth is expected to increase the demand for land, housing, water, health, education, jobs and urban services, and will also have negative impacts on the environment including air quality, urban natural assets and ecosystems (UN-Habitat, 2016a).

At the same time, Uganda's climate is changing: the temperatures are rising, climate induced hazards like droughts and floods are on the rise and pose serious development constraints and risks to urban economies and populations. What is particularly worrying is that the climate is changing amidst high poverty levels and high dependence on natural resources including climate itself. Moreover, the widespread degradation of the environment and natural resources, and the inadequate capacity to adapt to climate change impacts are compounding the country's vulnerabilities. Vulnerability to the effects of climate change is threatening to destroy the country's economic gains and this could hinder social and economic development.

Uganda's long-term development agenda, as articulated in the Uganda Vision 2040, is to enhance socio-economic transformation and transit from a low-income country to an upper middle-income status by 2040 (Government of Uganda, 2010). Both the Vision 2040 and National Development Plan recognize that urban areas are centres of economic growth and development and are thus drivers to faster foster socio-economic transformation. For example, poverty levels in Uganda are much lower in urban areas at 9.3% than in rural areas at 22.8% (Government of Uganda, 2014a). The Vision 2040 recognizes that for urban areas to contribute to the much-needed socio-economic transformation, a lot of investment in better urban systems is required to enhance productivity, liveability and sustainability. Currently, however, Uganda lacks adequate capacity to plan, manage and guide urban growth and development (UN-Habitat, 2012), which has led to the emergence of unplanned urban developments that are associated with many challenges including urban poverty, poor housing (slums), lack of basic infrastructure services and vulnerability to natural disasters and the impacts of climate change. The urban poor are particularly vulnerable to the effects of climate change since they live and work in informal settlements that are more exposed to hazards.

Uganda's development agenda also recognizes that building climate resilient cities will promote structural transformation, green economy, reduce poverty, and the overall achievement of sustainable development (Government of Uganda, 2010). Building the resilience of urban systems requires strengthening the capacity of the government and urban authorities to assess vulnerabilities and developing and implementing appropriate interventions, but this has often been hindered by lack of adequate and accurate information. In view of the above, UNDP is providing support to the Government of Uganda through the Office of the Prime Minister (OPM) – Department of Disaster Preparedness and the Ministry of Lands, Housing and Urban Development (MoLHUD) to undertake urban climate change profiling exercise in selected towns in Uganda to create a database for climate change planning and decision-making. Profiling urban climate change provides an opportunity to examine the current and future climate change in urban areas, the climate change vulnerabilities and reflect on the elements that can contribute to building urban resilience.

This report documents the climate change profile of Uganda's urban areas. The document profiles

the current climate and future climate, the vulnerabilities of urban areas to the impacts of climate change and factors contributing to vulnerabilities, as well as avenues of building urban areas that are vibrant, inclusive, sustainable and resilient in a changing climate. The document is aimed at informing policy and decision makers, and urban practitioners operating at national and local government agencies as well as civic organizations on how to guide climate compatible urban development.

1.1 Urbanisation, climate change and sustainable development

Urbanization and urban growth are used to define a country's development, although the manner in which the urbanisation process is managed determines the eventual benefits from the urbanization process. According to UN Habitat (2016), cities are drivers of global transformation and sustainable development. For example, while 54% of the world population (54%) is urban, cities account for 80% of the world's GDP. By the middle of this century, the global urban population will have risen to 66%. Thus, there is increasing focus on cities in efforts to address sustainable economic growth, development and prosperity.

Uganda's urban population has increased rapidly from 1.67 million in 1991 to 7.43 million persons in 2014. In the same period, the proportion of the urban population has also significantly increased from 10% in 1991 to 21.4% (Government of Uganda, 2016a). Though the country's urban population is still relatively small, the contribution of urban areas to national income is far greater than their share of population. For example, Kampala city has only 4.3% of Uganda's population (20.2% of the country's urban population) but accounts for 60% of the country's GDP and about 80% of the country's industrial and commercial activities (Kampala Capital City Authority, 2014). Projections indicate that 50% of the population could be urban within the next 50 years or less (See Figure 1).

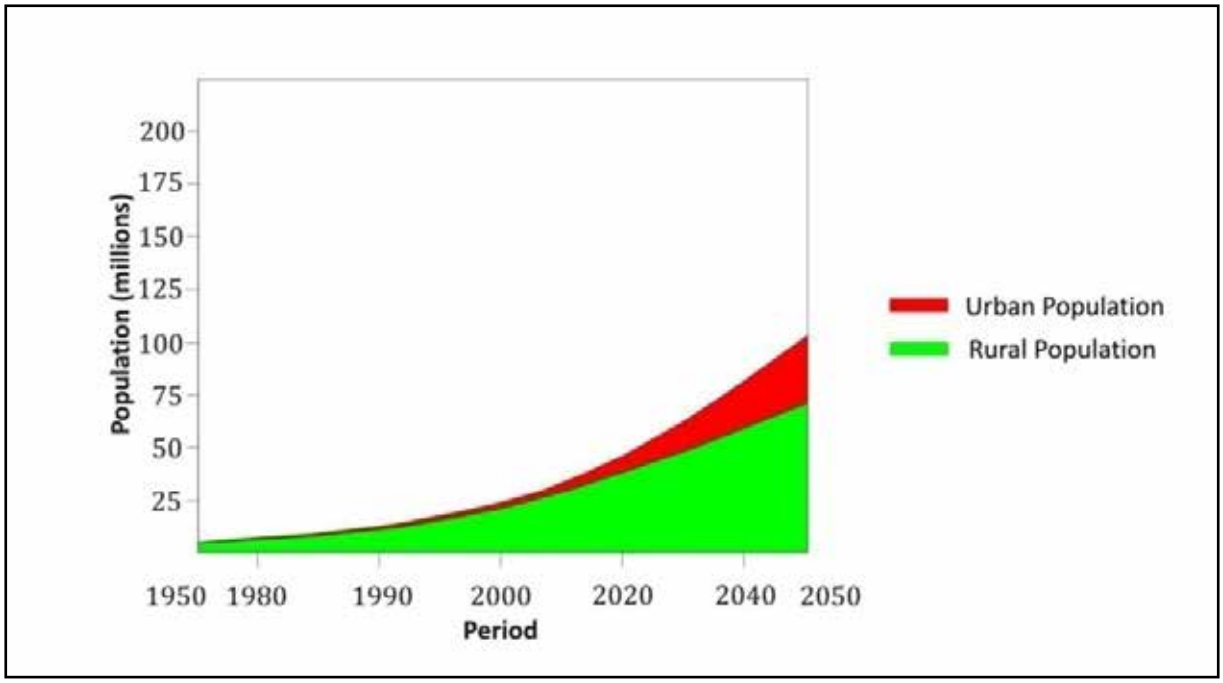


Figure 1: Rural and urban population growth trends 1950-2050 (Source: Twinomuhangi, et al, 2015: Data source: UN Population Division, 2014, Government of Uganda, 2016a)

The rapid urbanisation, coupled with the urban development challenges that the country is face with, could have a marked impact on landuse change, including urban sprawl, encroachment on wetlands, urban forests and other fragile ecosystems, and exert pressure on urban infrastructure and services. The rapid urbanisation could also result in increased slum settlements, unemployment and urban poverty culminating into the country's inability to achievement of a middle-income status in line with the Vision 2040 (Twinomuhangi et al, 2015). It is against this background that Uganda's development agenda is geared at enhancing sustainable urban development so that urban areas can further drive the country's socio-economic transformation. However, the achievement of sustainable urban development is being constrained by climate change, which is threatening roll back cities' contribution to economic growth and the overall attainment of sustainable development. Climate change, attributed to increase in greenhouse gas (GHG) emissions originating from human activity, is one of the greatest human development challenges of the 21st Century with adverse impacts capable of undermining the ability of all countries and regions to achieve sustainable development (United Nations, 2015b). Scientists have reported that 2015 was the hottest year in history by wide margin, as average temperature for the year was 0.75°C warmer than the global average (BBC, 2016).

Urbanisation is central to the climate change debate and climate agenda because urban areas are both drivers and victims of climate change. Cities are the main sources of increased GHG emissions. For example, whereas cities cover less than 1% of the earth's surface and account for 54% of the world's population, they consume 75% of the world's energy and are responsible for up to 70% of the global GHG emissions. Between 1950 and 2005, the level of urbanization increased from 29% to 49%, while global carbon emissions from fossil fuel burning increased by almost 500% (UN Habitat 2016b).

On the other hand, the impacts of climate change exacerbate the vulnerability of urban systems (Taylor and Peter, 2014). In particular, African cities are reported to be highly vulnerable to gradual shifts in temperature and intense rainfall, and to changes in the frequency and/or severity of extreme events, such as fires, floods, heat waves and storm surges. Slums and informal-settlements, in which most urban dwellers reside, are in particularly high-risk locations within cities because they are often on marginal land avoided by regulated property developers, and they also lack the requisite basic infrastructure and services to withstand the effects of climate change (Taylor and Peter, 2014). Most urban households, particularly the urban poor, are increasingly becoming vulnerable to declining availability of and/or increases in the price of, food, water, energy and transport, which reflect and sometimes amplify climate change related impacts elsewhere (for example in distant water catchments, agricultural areas and electricity generation). With the high concentrations of people, buildings, infrastructure and economic activity, the effects of climate change can disrupt the basic functioning of urban services and translate into widespread implications to infrastructure, economies and inhabitants (UN Habitat, 2016). This makes building resilient urban systems more pressing. As climate changes, it will take careful intervention and planning to ensure that cities grow in a sustainable manner in a changing climate, and that the poor benefit from city growth in a sustainable way.

Globally, the year 2015 was significant for the sustainable development and climate change agendas. The new global development agenda is guided by the 2030 Agenda for Sustainable Development launched in New York in September 2015, at which 17 Sustainable Development Goals (SDGs) were adopted by all the UN member states to build on the progress achieved under the Millennium Development Goals (MDGs) (United Nations, 2015a). The overarching goal of the global sustainable development agenda is to eradicate extreme poverty by 2030 and to ensure

sustainable development while 'leaving no one behind'. The SDGs reflect a global aspiration for faster progress over the next 15 years and the need for a profound structural transformation that will overcome the obstacles to sustained prosperity.

Regarding the climate change agenda, the Paris Climate Change Agreement was also adopted in Paris, December 2015 by all the UN Member States at the twenty-first Conference of Parties (COP21) of the United Nations Framework Convention on Climate Change (UNFCCC) to guide global climate change response. The 2030 agenda for sustainable development and the Paris Climate Change Agreement are closely related. Climate change impacts can slow and potentially even reverse progress on achievement of the SDGs, but well-designed climate change policies and plans can advance national and local development objectives driving the achievement of SDGs. On the other hand, sustainable development policies and plans geared at achieving SDGs can help to increase climate change resilience and reduce greenhouse gas emissions (Northrop *et al.,* 2016).

The new global sustainable development agenda recognizes the challenges associated with rapid urbanization and need for sustainable urbanization. The agenda also recognizes that the survival of urban societies is at risk because of climate change and its impact. To that end, specific SDGs are dedicated for addressing the two challenges (United Nations, 2015b). SDG 11 urges countries to make cities and human settlements inclusive, safe, resilient and sustainable, and SDG 13 urges countries to take urgent action to combat climate change and its impacts. Apart from SDG 13, climate action and resilience have been integrated throughout the SDGs Northrop et al., 2016). The UN requires member states to develop practicable responses (including policies, plans and strategies) to implement both the SDGs and the climate agenda.

For Uganda, implementation of the SDGs and the Climate Change Agreement provides new opportunities to foster sustainable development, while at the same time addressing the impacts of climate change and ensure mutually beneficial outcomes. The Government of Uganda (GoU) recognizes this opportunity and integrates it in its development agenda. The principle of sustainable development runs through the Constitution of the Republic of Uganda 1995, the Uganda Vision 2040, and the Second National Development Plan (NDPII) (Government of Uganda, 2017b). Implementation of the SDGs, responding to climate change and promotion of the green economy are the main tenets of Uganda's socio-economic transformation and achievement of the Vision 2040.

At the same time, the GoU recognizes sustainable urban development as a pillar to the achievement of the country's development agenda. The Vision 2040 foresees well-planned urban centres that attract investments, increase economic growth and create jobs to attract large populations and in the process, relieve pressure on the available land for other economic activities such as commercial agriculture. The challenge is that Uganda's urban areas are not well planned and the existing urban infrastructure is inadequate. These constraints coupled with urban management and governance challenges reduce the ability of Uganda's urban centres to cope and respond quickly to extreme weather events and climate change related risks and disasters. It is thus important to understand the climate change vulnerabilities of urban areas and to build their adaptation capacity.

It is against this background that UNDP supported the preparation of national urban climate change profile for Uganda. The profiling is aimed at helping policy-makers at the Ministry of Lands, Housing and Urban Development (MoLHUD) and other GoU Ministries, Departments and Agencies (MDAs), Local Governments (Urban Authorities) and local communities to get an insight into climate change challenges affecting urban development and to priorities interventions from addressing climate change in urban systems.

1.2 Why profile urban climate change in Uganda?

1.2.1 Climate is changing globally and Uganda is not spared

Whereas climate is naturally variable (i.e climate varies on all time scale season to season, year to year, decade to decade etc,), climate change is a shift in the statistical properties of a climate system over long periods of time, typically decades or longer (World Bank Group, 2015). The Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) finds, beyond reasonable doubt that the earth's climate is warming, and that since 1950s the rate of warming has been unprecedented compared to the previous decades and millennia (IPCC, 2013). The IPCC also finds that there is 95% scientific certainty that human activity is responsible for change in climate is attributed to increased concentrations of greenhouse gases (GHG) in the atmosphere. There is evidence of warming across Africa over the last 50-100 years with wide spread impacts ranging from droughts, changing rainfall, melting of snow and ice, rise in sea level and other extreme weather events, which will affect food security, water availability, health and development efforts across the continent (IPCC, 2014). Uganda, and its urban areas will not be spared by climate change, it is already becoming warmer and rainfall patterns have changed considerably over the past decades. The challenge is that there is not enough historical data to show the observed trends implying that planners will have to deal with considerable uncertainty about future climate conditions (Climate and Development Knowledge Network - CDKN, 2014). Supporting climate resilient urban development in Uganda requires understanding the current and future climate, and in the absence of this information, climate profiling is a necessity.

1.2.2 Understanding of urban climate change vulnerabilities

Uganda's urban areas are still struggling to meet the basic needs of their residents such as clean water, sanitation, health, clean energy, waste management, and mass transport. But urban areas also face significant environmental and climatic challenges that are independent of climate change, such as ecosystem degradation, urban heat island effect, air quality, and climate extremes (World Bank, 2011a). In conjunction to these challenges are the impacts of climate change e.g. flooding and droughts, that which compound these challenges through short-term and long-term effects on human health, physical assets, economic activities, and social systems, depending on how well prepared an urban area is and how it responds.

Apart from the direct impacts, urban areas are also impacted indirectly by climate change through the effects it has on areas and systems outside the urban areas. For example, droughts and floods could affect the supply of food, water (quantity and quality) and energy to cities when they affect the source areas. Urban areas could also experience increased in-migration arising from rural population pressured by droughts or extreme weather events. Such in-migrations could create an enormous social, health, infrastructure and management challenge for urban authorities, subjecting them to unplanned population growth. In particular, the impacts of climate change heighten vulnerability of poor and marginalized groups in the informal settlements who are among the most exposed to disaster risk.

The country's urban infrastructure (transport, and residential and public building) is already suffering from the extreme weather events. Since climate variability is likely to increase in the future, it is urgent that vulnerabilities are fully understood and addressed. The impacts of climate change could also affect the quality of health of urban residents. Cases of water-borne diseases such as cholera, typhoid and dysentery reach epidemic levels in many urban areas during floods. Water-borne diseases may also occur during droughts because of reduced availability of water to

wash and maintain basic hygiene, resulting into unsanitary conditions. Again, the most at risk are the urban poor in slums and informal settlements where sanitation infrastructure is inadequate or lacking. A warming climate and related extreme weather events (heat waves) will alter the thermal comfort experienced in buildings and this could cause ill-health and mortality in populations thereby leading to unconscious physiological changes – hyperthermia, sweating, and changes in the blood flow, among others.

Therefore, profiling climate change in urban areas is necessary to document the vulnerabilities of urban systems and population to climate change. Information on vulnerabilities will inform adaptation planning and efforts to building adaptive capacity and urban resilience.

1.2.3 Building adaptive capacity and urban resilience

A resilient urban area is one that is prepared for existing and future climate change impacts, thereby limiting their magnitude and severity. A resilient city is also able to respond quickly and effectively, in an equitable and efficient way. Moreover, building resilience requires not only robust decision making by those in positions of formal authority, but also strong plans, institutions and social relationships that can provide a safety net for vulnerable populations.

Currently, however, climate change is not taken into consideration in urban planning and urban development programmes at national and local levels. Apart from Kampala city, most urban areas in Uganda are implementing structure plans, physical development plans, urban development plans that are not climate proofed, having been developed before climate change became apparent. In addition, there is no climate change institutional framework at the local level to spearhead climate change response. So far only KCCA has a stand-alone climate change strategy and institutional framework.

But with the realization that urban centres are highly vulnerable to climate change and that its impacts could hinder not only the achievement of sustainable urban development but also the Vision 2040, Uganda has prioritized building urban resilience. Uganda's National Climate Change Policy, NDPII and NDC recognize that building urban resilience should be an integral part the country's climate resilient programme. Nonetheless, building adaptive capacity in the urban areas is being constrained by lack of climate information and a knowledge base. In addition, climate change awareness is lacking among the urban authorities' technical staff and decision makers and wider public. Profiling climate change will provide information and raise awareness on the extent of the problem and the options available for building resilience.

Currently, Uganda is developing a National Physical Development Plan and this is an opportunity to integrate climate change concerns in national urban development policy and planning. In addition, urban areas are reviewing their structure plans/physical development plans and five-year development plans. Through both formal planning activities and informal preparations, urban areas can build their adaptive capacity. Profiling climate change is an important step in building urban resilience. Once information on current and future climate change trends, vulnerabilities and adaptive capacity is profiled it will assist adaptation planning and decision-making.

1.2.4 Urban areas are crucial for low carbon development pathways

Since cities are the major sources of increased GHG emissions, they can play a significant role in emission reduction more especially in energy use, urban transport and waste management. Bloomberg et al., (2014) observe that urban actions could decrease global greenhouse gas (GHG) emissions by 3.7 GtCO2e below what national actions are currently on track to achieve in 2030, and by 8.0 GtCO2e in 2050.

Uganda has one of the world's lowest GHG emissions per capita, estimated at 3.9 tons carbon dioxide, far below the global average of approximately 7.99 tons of carbon dioxide. The country's contribution to the world's total GHG emission is estimated at 0.09% (Government of Uganda, 2015). However, Uganda GHG emissions are on the rise and could increase significantly by 2030, more especially with the expected developments in the oil and gas sector, and from increased urbanisation. Moreover, Uganda is a party to the UNFCCC, Kyoto Protocol and Paris Climate Change Agreement, and is thus mandated to fulfil its global commitments on climate change, including GHG emission reduction. Uganda has committed itself in its National Determined Contributions (NDC) to UNFCCC to a 22% reduction in GHG emissions by 2030 under the Business as Usual (BAU) scenario through implementation of policies and actions in energy supply, forestry and wetland sectors. Uganda's priority areas for mitigation are agriculture, land use and land use change and forestry, energy, transport, waste, and industrial processes and product (Government of Uganda, 2014b).

Urban areas utilize the biggest proportion of the country's energy and have the biggest share of industries, vehicles, infrastructure and buildings, which are makes them main sources of GHG emissions. Most of the fossil fuels consumed in Uganda are used in the transport sector. Most of the vehicles are in urban centres implying that urbanisation contributes greatly to Uganda's GHG emission. For example, about 60% of vehicles in Uganda are based in Kampala, even though the Kampala road network is only 0.083% of the estimated road length in Uganda. In addition, urban areas highly depend on biomass (charcoal and firewood) as a source of energy for cooking which increases deforestation and degradation of forests in the urban, peri-urban and rural areas. In addition, urban expansion has often encroached on wetlands, forest and open spaces. Thus, urban areas not only increase the emission of GHG, but also lead to land degradation, which undermines the resilience of ecosystems and their ability to deliver ecosystem services. Profiling climate change in urban areas highlights these challenges and the options to mitigate GHG emissions through promoting sustainable energy and following a low carbon development path.

Policy and decision makers in central and local government need to know that there are choices available for investment in energy, transport, infrastructures and waste management that reduce future GHG emissions while at the same time improving air quality, increasing climate resilience and promoting local economic development and poverty reduction. Profiling climate change can guide decision makers in selecting urban development programmes and projects that promote low carbon development pathways that have adaptation co-benefits like renewable energy, green transport and infrastructures, sustainable waste management practices and ecosystem protection. Every urban area has the responsibility to solve the climate change challenge, and without significant reduction in local emissions; it will be impossible to achieve the overall aim of the Paris Climate Agreement. Estimates suggest that if local governments were to select a low carbon path for the five sectors with highest levels of GHG emissions (residential and commercial buildings, transport and waste), global GHG emissions could be reduced by about 47% by 2050 (Bloomberg, et al., 2014). Uganda intends to mitigate GHG emissions in the context of its development goals and by pursuing low carbon resilient futures, and cities can help achieve this goal, and profiling climate change can serve as a basis for mitigation measures.

1.2.5 It is urgent to protect urban natural assets and ecosystems in a changing climate

Healthy urban ecosystems enhance adaptation to climate change by reducing the risk of impacts from climate extremes and disasters on urban systems. However, rapid urbanization has contributed to declines in urban natural capital and ecosystem services. In Kampala, for example, wetlands have been greatly degraded due to increase in population, commercial and industrial development.

Ecosystem degradation undermines the ecosystem protection function against natural hazards and disasters, including climate change related hazards and disasters. Climate change impacts exacerbate ecosystem degradation, which in turn triggers more humanitarian and environmental disasters and reduces nature and societies' security and resilience. Profiling climate change in urban areas will increase the understanding of the value of urban ecosystems and enhance the ability of national and local governments to make well-informed strategic and well-informed decisions to protect and manage urban ecosystems as an integral part of promoting green urban development.

1.2.6 Greening cities for green growth and sustainable development

Achievement of a green economy is prioritized in the Uganda Vision 2040, NDPII and the National Climate Change Policy. Uganda has developed a Green Growth Development Strategy (GGDS) whose aim is "an inclusive low emissions economic growth process that emphasizes effective and efficient use of the country's natural, human, and physical capital while ensuring that natural assets continue to provide for present and future generations" (Government of Uganda, 2017b). Climate change resilience and low carbon development are among the pillars of a green economy. In addition, the achievement of green cities is one the opportunities recognized in Uganda's GGDS. Achievement of green cities in Uganda will require an integrated urban approach that takes into account climate change. Promoting green cities has multi-benefits, including achieving both adaptation and mitigation and enhancing the co-benefits between them. At the same time, it promotes local economic development, poverty reduction and environmental sustainability.

The design and use of the built environment is a critical area for climate change mitigation because the built environment consumes most of the energy. In this regard, many efforts can potentially be put in place to build urban resilience and developing socio-ecological adaptive capacity. These include investment in green infrastructure, such as parks, gardens, wetlands, and green roofs that contribute to resilience under a changing climate, while at same time deliver ecosystem services and mitigating GHG emissions. Acting now to support cities to plan investment in a low carbon and integrated way, before they are locked into unsustainable development paths, will help them become centres of sustainable, long-term economic growth, with infrastructures that maximize agglomeration economies and resilience to future climate changes. Profiling climate change is one of the opportunities for implementing the GGDS to promote green cities and achieving a green economy in Uganda.

1.3 Methodology for profiling urban climate change for Uganda

The climate change profiling methodology deployed was based on different approaches and sources of information that were systematically compared and cross-checked through a triangulation process to ensure the veracity of the information. The collected data came through analysis of historical climate trends and projecting future climate, and assessing vulnerabilities and adaptation options. Literature review, key informant interviews, face-to-face meetings with officials in urban authorities and focus group discussions were some of the data collection methods.

1.3.1 Selection of urban areas for the profiling

The profiling was conducted in 21 urban centres. The urban centres were selected from the list provided in the TORs in consultation with the MoLHUD, OPM and UNDP (see Table 1 and Figure 1). The selected urban areas include Kampala City, 14 Municipalities and six Town Councils. However, the assessments in Kampala covered the whole of the Greater Kampala Metropolitan Area (GKMA). To that end face-to-face meetings were also held with urban officials in Kira Municipality, Makindye Ssabagabo Municipality, Mukono Municipality, Nansana Municipality and Wakiso Town

Council, which were not originally on the selected list of urban areas. The reason behind this was because the climate change challenges of Kampala city extend the greater Kampala area and addressing them requires a territorial/regional approach that covers the entire region. In addition, during consultations with KCCA, the city officials also requested that the Greater Kampala be assessed as whole unit.

Table 1: Selected Urban Centres for Profiling Climate Change

SN	Urban Centre	District	Region
1	Kampala Capital City Authority, and Urban Council in Greater Kampala	Greater Kampala	Central Region
2	Entebbe Municipal Council	Wakiso	Central Region
3	Masaka Municipal Council	Masaka	Central Region
4	Mukono Municipal Council	Mukono	Central Region
5	Jinja Municipal Council	Jinja	Eastern Region
6	Kamuli Municipal Council	Kamuli	Eastern Region
7	Mbale Municipal Council	Mbale	Eastern Region
8	Arua Municipal Council	Arua	Northern Region
9	Gulu Municipal Council	Gulu	Northern Region
10	Lira Municipal Council	Lira	Northern Region
11	Moroto Municipal Council	Moroto	Northern Region
12	Fort Portal Municipal Council	Kabarole	Western Region
13	Kabale Municipal Council	Kabale	Western Region
14	Kasese Municipal Council	Kasese	Western Region
15	Mbarara Municipal Council	Mbarara	Western Region
16	Nakasongola Town Council	Nakasongola	Central Region
17	Malaba Town Council	Tororo	Eastern Region
18	Amudat Town Council	Amudat	Northern Region
19	Paidha Town Council	Zombo	Northern Region
20	Kiruhura Town Council	Kiruhura	Western Region
21	Mpondwe-Lhubiriha Town Council	Kasese	Western Region

Figure 2: Location of selected urban areas for the study *Source: NUCCP, 2017*

1.3.2 The HIGS framework for assessing vulnerabilities

The main approach used in this study was based on the Hazard, Infrastructure, Governance and Socio-economic (HIGS) framework (Asian Climate Change Alliance, 2014) was used to conduct a rapid assessment of urban vulnerabilities to climate change impacts vulnerabilities using four sets of variables, which highlight the vulnerable features (see Figure 2). The four variables are hazards, infrastructure, governance and socio- economic characteristics were used to assess the vulnerabilities.

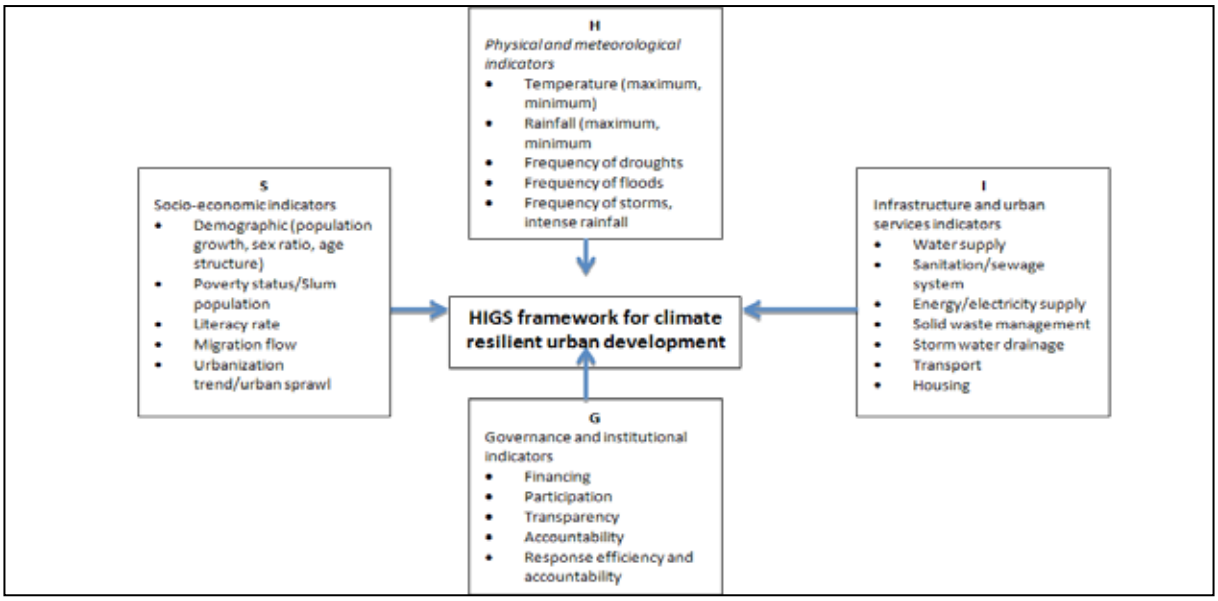


Figure 2: The HIGS Framework and List of Variables (Source: Asian Cities Alliance, 2014)

1.3.3 Analysis of historical climate trends and projecting future climate

Historical climate simulations were conducted by analyzing historical data that spanned from 1975-2005 (30 years) of the two climatic variables: rainfall and temperature. The historical data consisted of model data from European Centre for Medium-Range Weather Forecasts (ECMWF) Interim Re-Analysis (ERA-Interim) and Climate Research Unit (CRU) data sets. This data was on a monthly scale from which annual totals for rainfall and mean annual temperature were computed. The analysis considered climate variability as measured by the Coefficient of Variation (CV) as well as trends for total annual rainfall and annual mean temperature of the selected urban areas. Analysis was done using R-programming to obtain the coefficient of variability and trends for the key climate parameters.

In the projection of future climate, two Global Climate Models (GCMs) of EC-EARTH CGCM and NorESM1-M that were used in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC, 2013) under the Coupled Model Intercomparison Project Phase 5 (CMIP5). The models were downscaled to a 0.44° x 0.44° (50km by 50 km) grid resolution across Africa under the COoRdinated Downscaling EXperiment (CORDEX) using SMHI-RCA4 Regional Climate Model. Each GCM was downscaled using SMHI-RCA4 RCM results over the period 2021 to 2050 (30 years) for Representative Concentration Pathways (RCP)[1] 4.5 and RCP 8.5. This data has been used in understanding regional climates as well climate change assessment in various parts of Africa such as Endris *et al.* (2013) and Kalognomou, *et al.* (2013).

The results of an ensemble of the two GCMs under RCP 4.5 and RCP 8.5 were analyzed using the Grid Analysis and Display System (GrADS) as well as R software to obtain the spatial averaged values of rainfall and near-surface temperatures for each of the selected urban centres. Future projections per decade are presented for 2020s (2021-2030), 2030s (2031-2040) and 2040s (2041-2050). The projections were then compared with a baseline climate period of 1975-2005.

1 Representative Concentration Pathways (RCPs) are four greenhouse gas concentration trajectories adopted by the IPCC for its fifth Assessment Report (AR5) in 2014: RCP2.6, RCP4.5, RCP6.5 and RCP8.5. RCP4.5 is an intermediate scenario with emissions stabilising at radiative forcing of 4.5Wm-2 after the year 2100. RCP8.5 is a high emission scenario with ever increasing emissions to a radiative forcing of greater than 8.5Wm-2 by the year 2100.

1.3.4 Literature Review

A thorough literature review was conducted to collect information on the climate change vulnerabilities of Uganda and the selected urban areas. The Consultant reviewed a variety of documents including Uganda development framework documents (more especially Uganda Vision 2040 and NDP II), urban development policy documents (five-year urban development plans, physical development plans/structure plans, climate change related policy documents, sectoral reports, existing climate change vulnerability assessments reports, baseline databases, scientific articles, and documentation from other projects and studies. The Uganda National Climate Change Policy/Implementation Strategy and Kampala Climate Action Plan, and the process of their preparation, were reviewed and used as a reference point in preparation of this profile.

A matrix was completed while conducting the literature review to ensure the systematic collection of all relevant data. A reference list with all the reviewed documentation is presented in the References.

1.3.5 Key Informant interviews at the national level

At national level, the consultant met with officials in various Ministries, Departments and Agencies (MDAs), including the MoLHUD, OPM, UNDP, National Planning Authority (NPA), Climate Change Department (CCD) in the Ministry of Water and Environment MWE), Ministry of Local Government (MoLG) and National Environment Management Authority (NEMA) to collect background information and documents on urban development and climate change vulnerabilities and interventions; and information on existing and potential adaptation options. The Consultant also met the Climate Change Focal Persons in MDAs. Annex 3 provides details of stakeholders consulted.

1.3.6 Meetings with Urban Authorities

For each urban authority, the Consultant team held meetings with Physical Planner, Economic Planner, Environment Officer, Municipal/Town Engineer, and where possible the Town Clerk (See Annex 3 for the stakeholders consulted). In addition, at least one focus group discussion was conducted with a vulnerable community. In some urban areas, NGOs active in climate change/ environment management were met. In all these meetings, extensive data on climate change vulnerabilities as well as potential and existing adaptation options was collected.

The focus group discussions were structured around the HIGS framework but revolved around the following:

i. Vulnerability of urban economy or livelihood of communities to current climate change and/ or climate variability

Discussions were organized around current climate patterns. The main urban/local economic activities, urban infrastructure and services, and community livelihood assets were discussed, including how they are currently influenced by existing climate. Data on energy use, water and sanitation, solid waste management and the main environmental challenges was also collected.

ii. Vulnerability of urban areas/livelihood to developing/future climate change risks

The Consultant briefly presented expected climate projections to collect information on what would be the main climate change impacts on the urban economies, infrastructure and services, as well as on communities' livelihood/welfare in the future. Discussions were conducted according to how the identified local economic activities, urban infrastructure and services would be impacted by these climate projections, and how communities would be able to cope with the projected changes

in climate, leading to further discussions according to the third indicator below.

iii. Magnitude of barriers and opportunities to adaptation

Data on already adopted and implemented adaptation options, by urban authorities and communities according to current change and variability in climate were collected, and discussions were conducted on what other options urban authorities and communities would need to face future climate risks and what major challenges they face to put them in practice.

iv. Ability and willingness of the urban authorities/communities to implement adaptation measures in the long term

The team gathered data on the needs of the urban authorities and urban communities to implement adaption options in the long term, as well as their willingness as urban authorities to implement new practices.

The team also visited some urban communities that are highly vulnerable or are implementing adaptation practices to collect additional information on potential adaptation options that could be scaled up.

1.3.7 Validation Workshop

The urban climate change profiles report was validated in a stakeholders' validation workshop held on 7th May 2018 at Ridar Hotel in Seeta Mukono. The validation workshop was attended by 36 participants drawn from the MoLHUD, OPM, UNDP, Municipalities and Town Councils.

1.4 Structure of the report

Although the main focus of the study is climate change, the report takes a broader view and does not consider climate change in isolation. The study takes into consideration that linkages between urbanisation, climate change and sustainable development are central to building the resilience of urban systems to climate change.

The first chapter of this report provides the context of the study and synthesises the inter-linkages linkages between urbanisation, climate change and sustainable development, and provides a justification for profiling urban climate change. These inter-linkages are particularly important when bringing out the vulnerabilities of urban systems to climate change, urbanisation as a driver to climate change, and how addressing climate in urban development can generate triple wins: increasing resilience, reducing greenhouse gas (GHG) emissions and promoting sustainable development, which are elaborated in the final chapter. The chapter also describes the approach and methodologies deployed in the study.

Chapter two describes Uganda's urban development context focusing the trends and status of urbanisation and also discusses urban development challenges. The chapter discusses the urban development and climate change policy and institutional framework

Chapter three presents the climate profile of Uganda and the selected urban areas. In the chapter, the observed or historical climate, and projected climate are discussed in detail.

Chapter four provides a deeper analysis of the climate change impacts and vulnerabilities of urban systems. The considered view is that building the resilience of urban systems to climate change requires, among others, increased awareness and knowledge of the climate system and its impacts as well as the vulnerabilities and appropriate adaptation options.

Finally, chapter five provides a way forward towards building more resilient urban systems. The chapter highlights priority responses for addressing climate change based on the assessment of urban vulnerabilities to climate change and the current actions by urban areas to address the climate change challenges. The recommended options are mainly robust investment that can withstand the current and future climate while enhancing adaptation and mitigation co-benefits.

2. NATIONAL URBAN DEVELOPMENT CONTEXT

2.1 Introduction

The Uganda Vision 2040 indicates that Ugandans aspire to live and work in clean and well-planned communities. As Uganda strives to attain a middle-income status, more people will concentrate in urban areas. With the urban development challenges that are being experienced, including climate change, it is necessary to have well-planned and resilient cities. This chapter discusses Uganda's urban development context and highlights the challenges and opportunities for building resilient and sustainable cities in the country.

2.2 Current status of urbanisation in Uganda

As already mentioned in the previous chapter, Uganda has a small urban population (21%) but the country is urbanizing very fast at rate of 5.2% per annum (Government of Uganda, 2015a). As of mid-2016, Uganda had 259 urban centres, including one City (Kampala Capital City), 33 Municipalities, 163 Town Councils and 62 Town Boards (Government of Uganda, 2016a). Table 2, presents the number of urban centres by type and urban population based on the censuses from 1991 to 2014. The distribution of urban areas in Uganda is provided in Figure 3.

Table 2: Urban Centres by Type, Census Year and Population (1991-2014)

Type of Urban Centre	1991		2002*		2014**	
	Number	Population	Number	Population	Number	Population
City	1	774,241	1	1,189,142	1	1,507,080
Municipality	13	480,922	13	745,036	33	3,249,609
Town Council	33	338,901	61	1,065,209	163	2,361,033
Town Board/Township	20	75,589	20	na	62	308,142
Total	**67**	**1,669,653**	**75**	**2,921,981**	**259**	**7,425,864**

NB: * *The Urban Population of 2002 excludes the Population enumerated in Town Boards*
** *The Urban Centres are as of March 2016 while the population is as of 2014*

Source: Government of Uganda (2016a).

The Greater Kampala Metropolitan Area (GKMA) comprised of Kampala City, Entebbe, Kiira, Makindye Ssabagabo, and Nansana Municipalities have a combined population of more than two million inhabitants, which is a third of the country's urban population. Only four urban centres have a population of more than 250,000 persons (Table 3). The distribution of urban centres in Uganda by size is presented in Table 4 and the 20 largest urban centres account for 36% of the country's urban population (see Table 4).

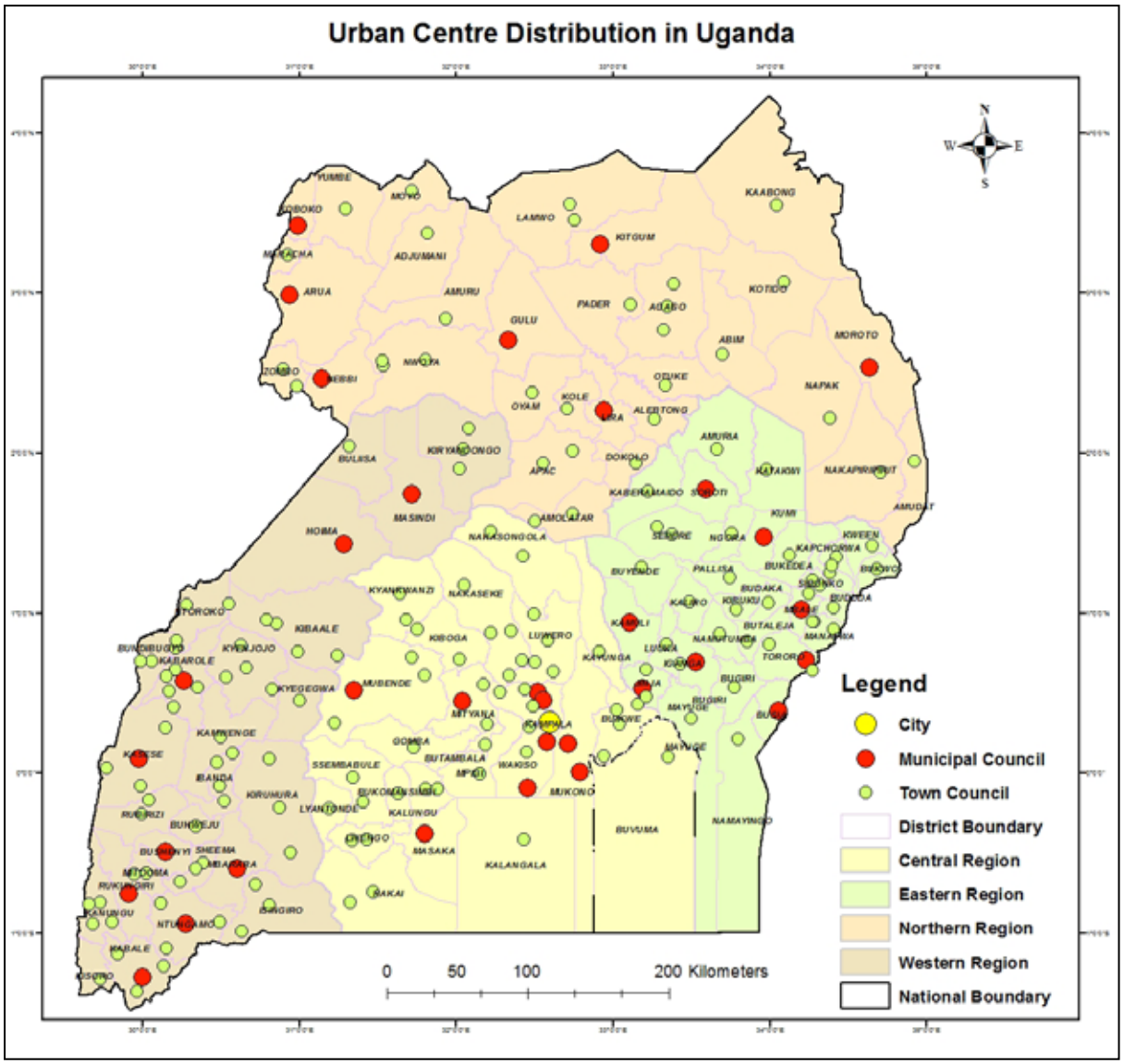


Figure 3: Distribution of Urban areas in Uganda

Table 3: Urban Centres by Size

Population	Number of Urban Centres	Total Population	Share of the Total Population
More than 250,000	4	2,473,006	33.3
100,000 – 250,000	7	926,831	12.5
50,000 – 99,999	16	1,164,443	15.7
25,000 – 49,999	24	851,015	11.5
10,000 – 24,999	91	1,382,409	18.6
Less than 10,000	117	628,160	8.5
Total	**259**	**7,425,864**	**100**

Source: Government of Uganda, (2016a).

The Central region is the most urbanized region in the country accounting for about 37% of the urban population. Eight of the 20 largest urban centres: Kampala, Kira, Mukono, Nansana, Masaka, Njeru, Entebbe and Wakiso, with a population of 2.5 million are found in the Central

region (see Table 4). Five of the 20 largest towns are in Western region (Mbarara, Kasese, Hoima and Fort Portal) with a population of 564,214; four are in Eastern region (Mbale, Jinja, Busia and Iganga) with a population of 278,948. The Northern region is the least urbanised with only three of 20 largest towns in the country (Gulu, Lira and Arua) having a population of 313,992.

Table 4: Uganda's twenty largest urban centres (1991-2014)

	Region	Urban Settlement	Population			Rank (UBOS, 2014)
			1991	2002	2014	
1	Central	Kampala City	774, 241	1,189,142	1,516,210	01
2	Central	Kira Town Council	-	-	313,761	02
3	Western	Mbarara Municipality	41,031	69,363	195,013	03
4	Central	Mukono Municipality	7,406	46,506	161,996	04
5	Northern	Gulu Municipality	38,297	119,430	152,276	05
6	Central	Nansana Town Council	-	-	144,441	06
7	Central	Masaka Municipality	49,585	67,768	103,829	07
8	Western	Kasese Municipality	18,750	53,907	101,679	08
9	Western	Hoima Municipality	4,616	27,934	100,625	09
10	Northern	Lira Municipality	27,568	80,879	99,059	10
11	Eastern	Mbale Municipality	53,987	71,130	96,189	11
12	Western	Masindi Municipality	10,839	28,300	94,622	12
13	Central	Njeru Town Council	36,731	51,236	81,052	13
14	Eastern	Jinja Municipality	65,169	71,213	72,931	14
15	Central	Entebbe Municipality	42,763	55,086	69,958	15
16	Northern	Arua Municipality	22,217	43,929	62,657	16
17	Central	Wakiso Town Council	-	14,603	60,911	17
18	Eastern	Busia Municipality	27,967	36,630	55,958	18
19	Western	Fort Portal Municipality	32,789	40,993	54,275	19
20	Eastern	Iganga Municipality	19,740	39,472	53,870	20

2.3 Urbanisation trends

In 2014, the urban population was 7.4 million having increased four fold from 1.7 million in 1991 (Government of Uganda, 2016a, UN Habitat 2016a) and with an annual urban growth rate of 5.2% (Government of Uganda, 2015a), 30% of Uganda's population could be urban by 2035. The number of gazetted urban centres has also been increasing overtime from 67 in 1991 to 75 in 20012, 197 in 2014, excluding town boards (UN-Habitat, 2016).

There are marked disparities in urban population growth trends within Uganda's four major regions. Until 1991, the central region accounted for 65% of the country's population and the other three regions (Eastern, Northern and Western regions) combined accounted for only 35% of the urban population. But by 2014 the situation had changed (Government of Uganda, 2016a) with the central region accounting for 37% of the country's population, while the other regions' share had increased from 35% to 53% (see Figure 4). Nonetheless, the Central region is likely to continue having a large portion of the urban population, given its economic, social and political primacy.

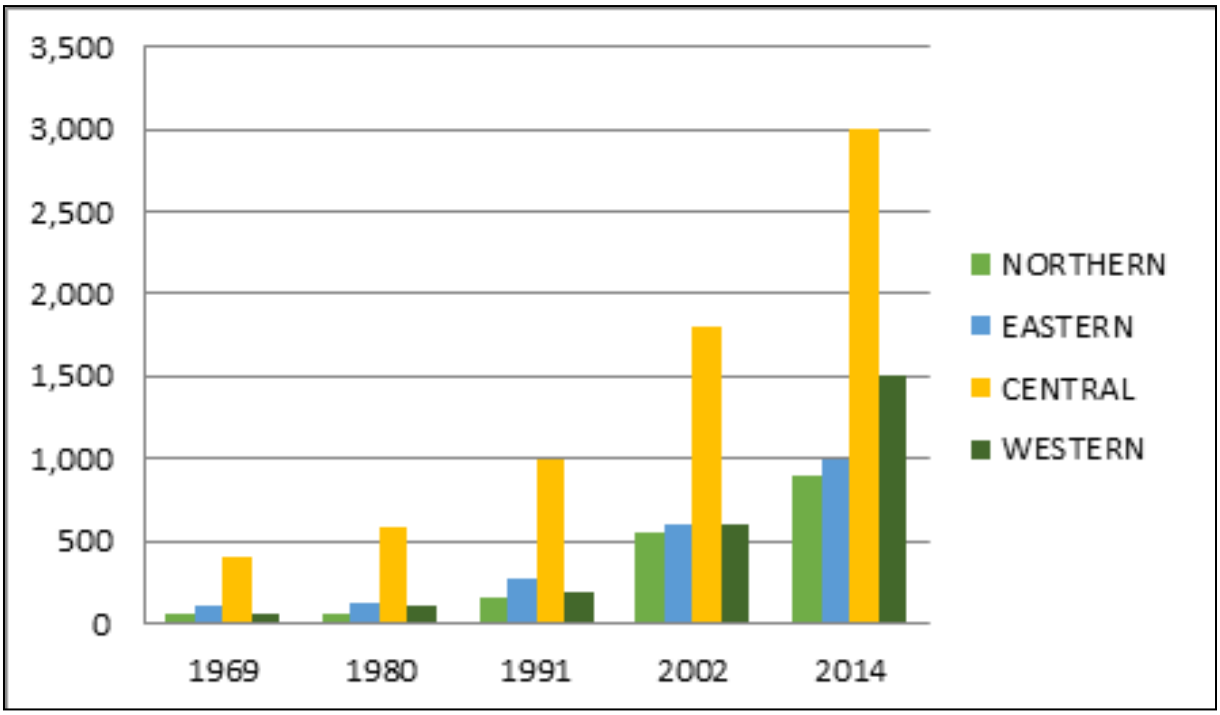


Figure 4: Uganda, regional urban population growth 1969-2014 (Data source: Government of Uganda, 2016a)

The urban centres that are experiencing rapid population growth are Wakiso Town Council (12%), Hoima Municipality (11%), Mukono Municipality (10%), Masindi Municipality (10%), and Mbarara Municipality (9%). The lowest population annual growth occurred in Jinja Municipality (2%). Kampala city has grown four times since 1980s in structure and shape, at a pace faster than its planning and structure re-adjustments. A city that had been estimated to host 300,000 at the maximum, is now home to almost 2 million people (Government of Uganda, 2015a)

The main drivers of urbanization in Uganda are rural urban migration, natural increase, and the creation of new districts (Government of Uganda, 2010), among others, as discussed below:

i. **Rural Urban migration,** where urban centres attract migrants from the countryside seeking education, jobs, or better access to basic services has resulted in urban expansion. Persistent rural poverty that causes people to migrate to urban areas with the hope of improving their livelihood partly explains the urban population growth rate for some urban areas. Kampala city is reported to have experienced rapid growth through rural urban migration because it is perceived as having better economic opportunities and higher quality of life (Ministry of Local Government, 2010).

ii. **Natural population increase:** Although not always recognized, urbanization is also a result of simple natural increase in population i.e. the surplus of births over deaths. Urban areas often contain a higher proportion of women of reproductive age than do rural areas, which can result in higher crude urban birth rates even if urban fertility rates are lower (Ministry of Local Government, 2010).

iii. **Annexation and re-classifications:** Annexation and reclassification of land around the periphery of urban areas as urban is one of the most important drivers of urbanization in Uganda. As urban centres grow (urban sprawl) they usually annex the neighbouring areas as the nearby population increasingly engages in non-farm activity. As a result, suburbs develop as urban

residents begin to commute. Currently, the expansion of urban areas is steadily advancing leading to engulfing of adjacent rural areas and other urban centres to form corridors, like is the case in the Greater Kampala Metropolitan Area.

iv. **Creation of new districts. Uganda Bureau of Statistics**, between 2002 and 2014, the growth in urban population was mainly due to reclassification of urban areas and creation of new districts (UBOS, 2015). The balkanization of administrative regions in which smaller districts have been curved out of larger districts is a major to Uganda's rapid urbanization (Ministry of Local Government, 2010). Since 1986, districts in Uganda have increased from 35 to 45 in 1998, 56 in 2002, 97 in 2010, and currently the districts are 117 (including KCCA). For each of the district created, the headquarters of the district is automatically gazetted as a Town Council, which qualifies its population as urban. Several of these towns rapidly expand outside their gazetted boundaries.

v. **Civil strife:** At a regional level, political/civil insecurity has been another driver of increased urbanization in Uganda, especially in the Northern region, where insecurity displaced a number of people resulting into a large influx of the population relocating to urban areas for protection. This factor explains why Gulu and Lira Municipalities have experienced rapid urbanization.

vi. The other factors that have driven urbanization in Uganda are pursuance of a liberalized economy and increased security that attracted the private sector investments in the urban economy through establishment of industries, housing estates, higher education institutions and commercial agricultural entities is greatly contributing to the expansion of urban areas. The real estate sector has steadily grown and driving the urban sprawl in the region that contributes to the urban corridors. This has influenced migrations into urban areas.

The Uganda Vision 2040 and the NDPII provide spatial frameworks for arrangement and organization of socio-economic activities on land at the national, regional, district and local levels to achieve optimal use and sustainable development, in which urban development entails establishment of better urban systems that enhance productivity, liveability and sustainability. The Vision 2040 provides guidance on the future of urbanization in Uganda. It foresees the establishment of four regional cities: Gulu, Mbale, Mbarara and Arua, as well as five strategic cities: Hoima (oil), Nakasongola (industrial), Fort Portal (tourism), Moroto (mining) and Jinja (industrial). The proposed cities have been identified as part of the urban corridor development (see Figure 5).

The GoU has finalized a National Urban Development Policy which will provides a framework for the management of urban areas. The GoU is in the process of formulating a National Physical Development Plan to guide urban planning and management. The urban development sector is responsible for promoting comprehensive physical planning for urban development, improving urban infrastructure services and utilities, creating an inclusive policy and regulatory framework for urban development, resilient cities, and increase availability of and access to land for urban expansion and investment (Government of Uganda, 2015a).

2.4 Urban Governance in Uganda

The achievement of urban development goals, and the overall development goals of Uganda, requires good governance that allows for the full participation at all levels: national, local and community. Ownership and sustainability of the development endeavours can only be guaranteed with active stakeholder engagement.

Uganda's National Programme for Good Governance in the context of poverty reduction (Government of Uganda, 2000) defines good governance as the efficient, effective and accountable exercise of political, administration and managerial authority to achieve society's objectives including the welfare of the whole population, sustainable development and personal freedom. In the Ugandan context, Uganda is multi-dimensional and covers all aspect of the exercise of authority by formal and informal institutions and is an important dimension of poverty reduction (UN Habitat, 2012). Governance gives an indication of the responsiveness of urban centres as well as their institutional framework. The existence of systems for good governance can support and strengthen the urban centres' response to climate change and natural hazards, in particular by meeting the needs of local communities through more effective prevention and preparedness measures, and the integration of risk management into long-term development planning.

Figure 5: Proposed regional and strategic cities (source: Government of Uganda, 2010)

Uganda's system of local governance is decentralized, in accordance with the 1995 Constitution of the Republic of Uganda and the Local Government Act 1997. The Ministry of Local Government (MoLG) is the lead agency mandated to guide, coordinate and harmonize local governance systems. Urban governance is part and parcel of the local governance system that involves a number of institutions at the national and local level. At national level urban authorities deal with a number of

Ministries, Departments and Agencies (MDAs) including: MoLG, MoFPED, MoLHUD, NPA, among others.

At the local level, urban authorizes are lower local governments under a District, except a city which is equivalent to a District. Thus, a city council exercises all functions and powers conferred upon a district council within its area of jurisdiction, including political, executive, and legislative powers and functions. However, the KCCA Act 2010 elevated Kampala City to an Authority and so it is not a local government but is governed at national level. Section 3(1) of the Local Governments Act 1997 stipulates that the system of local government shall be based on the district as a unit under which there shall be lower local governments and administrative units. Section 3(3) provides that in a city, the local governments are the city council and the division councils, while sub-section 4 provides that in a municipality the local governments are the municipal council and the municipal division councils. Section 3(5) provides that in a town, the local government is the Town Council.

Section 4(b) provides that a city division shall be equivalent to a municipality while 4(c) provides that a municipal division and a town council are equivalent to a sub-county. Section 5 of the 1997 Local Government Act, stipulates that in accordance with Article 197 of the Constitution, municipal and town councils are lower local governments of the district in which they are situated. This means that the lower urban local governments are legally enjoined to the district council. This implies that urban councils have no autonomy, which limits them in planning and decision-making, including addressing climate change.

The MoLHUD is responsible for providing policy direction, national standards and coordination of all matters concerning housing and urban development. The MoLG on the other hand has developed urban development programmes including, good governance, decentralization, community development, local finance, local economic development and social protection. MoLG is also responsible for strengthening the technical and institutional capacity of urban authorities to deliver service. The MWE is responsible for ensuring that urban development takes into account sustainable utilization and management of the environment and natural resources. MoFPED plays an important role in mobilizing and allocating public resources for all sectors of the government, including housing and urban development.

2.5 Urban development policy framework

Urban development endeavours are legal activities that have to be guided by the existing legal, policy and institutional framework. In Uganda, there are a number of laws, regulations, policies, strategies and institutions involved in the urban development process right from central government, ministries; government agencies to local urban authorities.

- Article, 190 of the ***1995 Constitution of the Republic of Ug*anda** provides for the district and urban councils to prepare comprehensive development plans. The constitution also highlights the roles of local governments in land management and conservation of environmentally sensitive areas.
- The **Uganda Vision 2040** is 'a transformed Ugandan society from a peasant to a modern and prosperous country within 30 years by 2040'. The Vision 2040 recognizes that key strategies and policy reforms must take place related to land, housing and the urban development sector. Well planned urbanisation and climate resilience are recognised as key drivers to achievement of the Vision 2040
- The **NDPII** is the second of the six NDPs designed to achieve the Uganda Vision 2040. The aim of the NDP is to propel Uganda to achieve a middle-income status by 2020 by strengthening

sustainable wealth creation, employment and inclusive growth. The NDPII prioritises planned urbanization and the achievement of better urban systems that enhance productivity, liveability and sustainability while releasing land for other purposes like agriculture.

- **The Local Government Act 1997 - Cap 243** provides for decentralization and devolution of functions from the centre to local governments to improve efficiency in service delivery. Local governments, including urban authorities, are mandated to prepare or cause to prepare Comprehensive Local Development and Physical Development Plans and deliver decentralised services, including waste management and overall environmental management. The Act also outlines the mandate of councils in respect of the services they are supposed to deliver to the population including road construction and maintenance, street lighting, and other services.
- The **Kampala Capital City Authority (KCCA) Act 2010** provides for the establishment of KCCA as the governing body of the Kampala Capital City on behalf of the central government. The Act also established the Metropolitan Physical Planning Authority to guide and oversee physical planning in the capital city and surrounding metropolitan areas in the neighboring Mpigi, Mukono and Wakiso Districts
- **The Land Act 1998 - Cap 227** specifies the mode of land ownership and control of land use. With respect to urban development, once zoning is done and the plan becomes law, owners have to conform to the approved plans no matter what existing land rights are held. The act provides for protection of land holding fragile ecosystems such as lakes, rivers, ground water, wetlands and other land reserved for ecological and touristic purposes for the common good.
- **The Physical Planning Act 2010** guides physical planning in Uganda. The Act declares the entire country a planning area. The Act requires that outline schemes and/or a physical development plans be formulated. The Act provides for the establishment of a National Physical Planning Board, district and urban physical planning committees to provide for the making and approval of physical development plans and for the applications for development permission. Physical development plans can be national, regional, district, urban or local physical development plan. The Act reaffirms the need for environmental impact assessment where a development application requires so in accordance with the National Environment Act.
- To enforce physical development plans, **National Physical Planning Standards and Guidelines** were formulated in 2011 with the basic aim of ensuring orderly, coordinated, efficient and environmentally sound social and economic development, and to secure the proper use of land.
- In addition to other development standards, **guidelines on environmental management** are highlighted with respect to buffer zones from lake shores, river banks forests, swamps among others rein-enforcing NEMA and National Forestry Authority guidelines.
- **Public Health Act, 1964 - Cap 281** specifies the rules and regulations regarding public health issues in respect of infectious diseases, vector control, buildings of various types and uses, as well as drainage and sanitation. It forms the basis to enforce building regulations in any planning area. The act specifies details of the building standards under Section 269-13 which apply to municipalities and towns, planning areas declared under the Physical Planning Act, urban councils, town boards, factories, public buildings, stores and schools.
- **NEMA Act Cap 153** requires the integration of environmental concerns in overall national and local planning. The Act requires that urban planning and development must integrate environmental concerns

- **The Uganda national urban policy 2017** aims at achieving transformed and sustainable urban areas by enhancing the quality of life, improve competitiveness, optimize land use, preserve the natural environment and save resources over time. This will ensure that growth is physically, environmentally, economically and socially responsive, and accords priority to fulfil redevelopment and densification strategies.
- **The Uganda National housing policy 2016 provides a** framework that promotes adequate housing for all. It is intended to address the various critical issues and challenges facing the housing sector, including addressing growing housing demand. In addition, seeks to address deterioration in housing condition as manifested in overcrowding, development of slums and proliferation of informal settlements characterized with lack of basic infrastructure and services within virtually all the urban centres.
- **The Uganda National Land Policy 2013** provides a framework for articulating the role of land in national development, land ownership, distribution, utilization, alienability, management and control of land. The policy is intended to ensure that the country transforms from a peasant society to a modern, industrialized and urbanized society. Some key issues addressed in the policy include the under-utilization of land due to poor planning and land fragmentation, environmental degradation and climate change, poor management of the ecological systems due to their trans-boundary nature and unsustainable exploitation arising out of the conflicting land uses and inadequate enforcement of natural resource management, standards and guidelines.
- **The National Landuse Policy 2006** aims to achieve coordination, sustainability and optimal land utilization for socio-economic development and transit from a backward, peasant society to a modern, industrialized and private sector driven economy. The policy addresses issues of agriculture, urbanization and human settlement, industrialization and infrastructure development, environmental management and conservation. It concretizes the role of physical planning in development and gives a general direction on land use planning and management, which is critical for urban development. The policy calls for ensuring planned, environmentally friendly, affordable and well-distributed human settlements for both rural and urban areas.
- **The National Physical Planning Standards and Guidelines 2011** guide the preparation and implementation of physical development plans to achieve orderly, coordinated, efficient and environmentally sound social and economic development. It consolidates existing standards relating to social, economic and physical infrastructure provision from various sectors for ease of implementation and enforcement. The Standards and Guidelines focus on forward planning, development control, plan implementation and raising quality of life.

In addition to the urban development policy framework, there are key climate change related policies that could guide climate resilient urban development and these include:

- **The Uganda National Climate Change Policy (NCCP) 2015** is the overarching policy guiding climate change response in Uganda. The policy aims to ensure that all stakeholders address climate change impacts and their causes through appropriate measures, while promoting sustainable development and a green economy. The Urban development sector is one of the prioritised sectors in the policy. Climate change response for urban development covers both adaptation and mitigation i.e. (i) promote well planned cities and urban centres that are resilient and robust enough to withstand climate change related risks and hazards; and (ii) decarbonising urban development aiming at the achievement of green cities that mitigate GHG emissions and strong urban economies. Develop and implement a climate change–induced

disaster risk management strategy.

- **Uganda's Nationally Determined Contribution (NDC) is the country's contribution to the implementation of The Paris Climate Change Agreement -** contribution towards curbing global temperature rise to below 2°C by the end of the century. The NDC prioritizes adaptation including increasing the resilience of human settlements, social infrastructure and transport. Regarding mitigation, Uganda house gas emissions in 2030 compared to BAU in the energy forestry and wetland sectors and promoting climate smart cities will play a big role in helping the country follow a low carbon development path.
- ***Climate Change Law:*** The GoU is preparing the Climate Change Bill and once enacted into Law it will provide a legal framework for strengthening implementation and coordination of climate change actions.
- **The Uganda Green Growth Development Strategy (GGDS) 2017/18 – 2030/31:** The strategy is aligned to the Vision 2040 and NDPII. The goal of the GGDS is 'an inclusive low emissions economic growth process that emphasizes effective and efficient use of the country's natural, human, and physical capital while ensuring that natural assets continue to provide for present and future generations'. Specific strategies are proposed in the area of planned green cities, sustainable transport and energy for a green economic growth. The strategy foresees support for comprehensive economic physical planning, efficient waste management, sustainable procurement and inter-linkage between the rural raw material production base and industrial production in cities. Others are sustainable transport and green energy.
- **Kampala Climate Change Action, 2016:** Kampala city is the only urban centre in Uganda that has developed a stand-alone climate change strategy/plan. The Kampala Climate Change Action is aimed at mainstreaming climate change response in all city services/sectors and putting the city on a climate resilient and low carbon development path. The Plan was developed to implement the NCCP and is aligned to NDP II and the NDC. Uganda's ambition in its NDC is to reduce GHG emissions by 22% based on the Business as Usual scenario by focus on a paradigm shift in key sectors including transport, energy, waste, built environment and cross-sectoral pillars of communication, participation, governance, urban planning and resilience. In line with adaptation, the Kampala Climate Change Action aims at reducing the number of people exposed to climate change impacts, reduce losses resulting from climate change related hazards achieve well planned and integrated neighbourhoods, reduced damage to public infrastructure and limited interruptions to city operations and revitalized ecosystems and public spaces.

2.6 Urban development challenges

The Uganda Vision 2040 recognises that Uganda's urbanization process is characterised by uncoordinated planning and developments leading to unrestricted sprawling of the major cities and towns and inadequate provision of basic urban services. The over concentration of development in Kampala has led to primacy. This is putting enormous pressure on the overall functioning of the city as compared to other urban settlements across the country.

As a signatory to the Habitat Agenda, Uganda commits to providing adequate and integrated environmental infrastructure facilities in all human settlements with a view to improving the quality of life. According to UN Habitat (2009), urbanization in Uganda has two dimensions: first an increasing growth path that continuously presents urban management problems and sustainability challenges, and second; the creation of districts, resulting in more urban centres with inadequate

administrative, financial, social and economic managerial capacity (UN Habitat, 2009). In this section, the challenges of urban development are presented.

2.6.1 Physical planning challenges

Until recently Uganda did not have an appropriate national development policy and regulatory framework to guide urban development and management. Until the Physical Planning Act 2010 was enacted, physical planning was guided by the Town and Country Planning Act 1964, which had provisions that were inconsistent with other laws such as the Local Government Act 1997, the Land Act 1998, and the National Planning Authority Act 2002. The existing land tenure system (mailo, free-hold and customary) constrains physical planning as it makes it difficult to implement physical development plans and enforce development control. This has been the greatest challenge of urban development in Kampala city where the delivery of services as roads, piped water, electricity is constrained by the high cost involved in compensating land owners.

Whereas most municipalities and town councils have physical development/structure plans, the technical and institutional capacity required to implement them is somewhat lacking (finance, human resources, technology etc.). Virtually, all major plans have no detailed plans to guide activities such as residential development, road construction and waste collection and disposal Ministry of Local Government, 2010). As a result, in many urban centres, development is ahead of planning. An example is Mbarara Municipality that has been having a structure plan but it was not implemented and it has been overrun by development. The lack of proper planning, coupled with governance challenges has led to the encroachment on important ecosystems

Physical planning is also constrained by lack of up-to-date planning information, including topographic maps, cadastral information and land tenure maps (Ministry of Local Government, 2010). Many urban centres lack human resources to formulate and implement physical development plans, and transform from analogue to digital technology in planning.

In Kampala, the unplanned rapid horizontal city development has caused structural and socio-economic challenges for the greater Kampala including: transport, environmental management, slums and unplanned settlements. The challenges affect the wider Greater Kampala Metropolitan Area (Entebbe, Kiira, Makindye Ssabagabo municipalities and Wakiso Town Council, and as far as Mukono and Jinja Municipalities, and Mpigi Town Council.

2.6.2 Energy supply and access challenges

Access to modern energy and energy security are critical for Uganda to attain its development agenda, is more importantly to achieve sustainable urban development. The country's energy balance comprises 88.8% biomass, 9.5% percent oil products and 1.7% electricity (most of which is hydro-electricity). Of the total biomass consumed, firewood accounts for 80%, charcoal for 4.2% and crop residues for 4.8% (Ministry of Energy and Mineral Development, 2016). Access to modern energy is a serious constraint to urban development. Only half of the urban population (51.4%) use electricity for lighting and only 4.4% use electricity for cooking. The majority of the urban population (89%) use biomass energy for cooking i.e. charcoal (58.2%) and firewood (31%), and 34.1% use kerosene for lighting (Government of Uganda, 2016a). Even where there is access to electricity, electricity supply shortage is manifested in frequent load shedding and high-energy tariffs, which negatively affected industry and business, which in turn constrains local economic development in the urban centres. A big section of urban households cannot even access electricity due to the high connection costs. The power tariffs are very high and most households cannot afford to use electricity for cooking but use traditional biomass energy, which translates into high

rates of deforestation and land degradation as well high GHG emissions from the forestry sector. It is estimated that by 2050, biomass energy will be short supply and there would be probably less potential for hydropower development due to a reduction in rainfall and water availability (Ministry of Water and Environment, 2015a).

The high costs of electricity, coupled with unreliable supply contribute to the high cost of doing business thereby reducing the country's competitiveness. It is thus essential to increase access to modern energy in urban areas to promote stimulate the growth of urban economies, reduce deforestation, improve air quality and above all promote green cities and climate resilience. SDG 7 obligates member states to ensure access to affordable, reliable, sustainable, and modern energy for all. With the Vision 2040 targeting 80% access to modern energy by 2040, there is still a lot to be done in this sector.

2.6.3 Urban housing challenges

Whereas, SDG 11 Target 1 requires member states to ensure access for all to adequate, safe and affordable housing and basic services, and upgrade slums; Uganda's rapid urbanization has not been matched with adequate capacity for planning and development control. Unplanned settlements are on the rise in urban areas in Uganda, and more especially the proliferation of slums and informal settlements. Substandard housing conditions are serious challenge with 27% of the housing units in urban areas built with temporary building materials (Government of Uganda 2017b). Slum settlements are characterised by informality, absolute poverty, unemployment, and poor living conditions i.e. substandard housing, overcrowding and limited access to urban utilities and services like waste management, electricity, clean water and sanitation, and drainage (UN-Habitat, 2012; Andrea, 2013). Slum settlements tend to be highly vulnerability to disaster risk, including those related to the impacts of climate change due to the inadequate adaptive capacity of the slum residents (Government of Uganda, 2015b).

2.6.4 Water and sanitation provision challenges

Safe water and adequate sanitation facilities are essential for good health, which enhances labour productivity and for poverty eradication (UN Habit, 2016a). However, in most of urban areas in Uganda, a big section of the urban population does not access clean and safe water supply and sanitation. While safe water coverage in the large towns is at 77% percent, coverage of sewerage services is at only 6 percent (Government of Uganda, 2017c). The rest of the inhabitants rely on on-site sanitation facilities predominantly pit latrines (Ministry of Local Government, 2010). In particular, unplanned settlement patterns leads to difficulties in supply of piped water and sewerage services. Water quality is reducing with increased water pollution, encroachment on wetlands, and the impacts of climate change more especially droughts and floods. While droughts reduce water availability, floods lead to water contamination. With the expected changes in climate, including rising temperature and reduced rainfall, Uganda's urban areas will be more water stressed by 2025 (Government of Uganda, 2015b).

2.6.5 Urban mobility and transport challenges

Urban centres also suffer from serious deficiencies in road infrastructure- inadequate road capacity, poor quality of roads, impediments on roads such as potholes, depressions etc which hinder free movement of vehicles. The poor condition of roads also contributes to traffic congestion and accidents. Many urban centres do not have street lighting and in those that have, the maintenance and performance is very poor. Streetlights are essential for providing lighting at night and also important for safety. The lack of public transport system in Kampala has led to increase in the

number of motor vehicles in recent years. As a result, urban transport and traffic is one of the most serious challenges faced in the major city of Kampala.

2.6.6 Urban governance and management challenges

Urban planning and urban services delivery in Uganda is constrained by governance challenges. Coordination challenges exist between the various MDAs and local governments involved in physical planning and urban development. Management conflicts often emerge between urban authorities and district authorities, given that municipal councils and town councils are not autonomous from districts. Governance challenges also exists between the national level (MoLHUD and MoLG) and the local levels. Some local governments and urban authorities do not implement the decisions of the National Physical Planning Board (the supreme body governing physical planning in the country) insisting that they are equally independent, and yet according the National Physical Planning Act local governments are supposed to be agents of the Board (Ministry of Local Government 2010). In addition, within local governments, local political leaders seem not to appreciate the need for physical planning and they do not often give it high priority in terms resource allocations. Many political leaders do not appreciate environment management services and often support the extension of developments in wetlands, open spaces and green spaces which complicates implementation of urban development plans and ensuring environmental sustainability. That aside, weak accountability in governance structures is a serious challenge, with many corruption cases reported in urban councils. Weak financial management undermines good governance because the citizens lose confidence and do not participate in urban governance and the diversion of resources hinders the achievement of development goals and targets. Community participation in planning and decision making, an essential aspect of urban governance, is in most cases lacking, implying that urban development in Uganda does not integrate the full aspirations of the community.

2.6.7 Urban poverty

Poverty and unemployment remain the major urban development challenges in Uganda. Whereas it is assumed that the urban population is not poor, most urban dwellers do not have any stable source of income and adequate source of livelihoods (Ministry of Local Government, 2010). The high urban population growth far exceeds job creation and most of the urban poor lack skills to access formal jobs and remain unemployed or is engaged in the informal sector. Slums are the major manifestations of urban poverty where people who lack means of livelihood predominantly live in dilapidated housing structures that lack basic infrastructure services. Urban youth unemployment rate is also very high. Most of the urban poor rely on the informal economy, where income is irregular and security risks are widespread. In Kampala, for example, the economic profile of urban poor shows that 25% of the urban poor are not employed, majority of whom are women and youths who lack adequate skills and education to enable them to find employment for example the slums of Kisenyi, Namuwongo Wabigalo, and Naguru among others. The urban poor suffer more from environmental degradation, as they are highly dependent on the environment for their survival, and also less resilient to disaster risk including those related to climate change.

2.6.8 Weak urban economies

The Uganda National Urban Policy 2017 observes that Uganda's urban economies are not highly productive or competitive. Most urban economies are dominated by the informal sector, and the increase in the urban population does not correspond to investment and job opportunities to propel growth. The urban economies have also failed to propel growth and development opportunities for the urban hinterland. Almost all urban centres cannot raise adequate local revenue to deliver services to the urban residents. Therefore, one of the challenges that urban centres are facing is to

promote local economic development by attracting local and foreign investment to achieve a viable economy and provide adequate employment opportunities and ensure productivity to full capacity in terms of revenue and other related resources. To promote economic growth in urban areas, the focus should be on the creation of a fair distribution of wealth among the population to reduce urban poverty. Although the rate of urban poverty has shown a decrease at a level of 19.0% in 2016, several studies indicate that the problem exists in the lack of housing and public facilities and a decline in the quality of living of urban dwellers.

2.6.9 Financing challenges

Urban centres are not adequately funded and this makes them lack capacity to execute their mandates and to deliver urban infrastructure and services. The biggest proportion of government funding to urban authorities is conditional grants, and local revue is grossly low and insufficient to fill the financing gaps. The development of physical development plans requires substantial amount of resources. In addition, a lot of funds are required to implement the physical development plans, more especially to compensating land owners of areas designated for public facilities such as roads, public open spaces, public health facilities to mention but a few. Putting in place physical infrastructure, utilities and services: roads, drainage, street lighting, waste management, social services, environment management all require a lot of funding which the urban authorities lack. Above all, the urban authorities lack funds to recruit qualified human resources, and in many of them the staffing structures are not filled implying they have human capacity challenges. That notwithstanding, urban financial management is also a challenge with widespread reports of weak accountability in governance structures.

2.6.10 Solid waste management

Uganda's urban centres are faced with poor solid waste management (UN-Habitat, 2012), which comprises public health, urban beauty and causes flooding. Under the 1997 Local Government Act solid waste management is the responsibility of urban authorities. Due to the high concentrations of people and economic activity, urban areas generate a lot of solid waste than they can adequately collect and dispose of. The Uganda National Urban Policy 2017 recognises that poor waste disposal is a nation-wide problem with approximately 13% of urban population disposing waste in gardens, 19% in pits and 32% heaping it in drainages and streets. In Kampala, the city authorities are only able to collect about 40 percent of the garbage generated each day (Ministry of Local Government, 2010). The problem is more widespread in slums and informal settlements that are not adequately covered by urban waste collection services. Most of the remaining waste is disposed of in open dumpsites. Some of the solid waste is disposed of anyhow and most times it finds its way into drainage channels and blocks them, and when it rains serious flooding is experienced. The disposal of waste in open dumpsites presents serious environment and health risks. Kampala city's climate change action plan (KCCA (2016) recognises that poor solid waste management is a key driver of vulnerability of the city to flooding.

Whereas 12 municipalities have put in place solid waste compositing plants through a NEMA led Clean Development Mechanisms (CDM) project: in Arua, Fort Portal, Hoima, Jinja, Kabale, Kasese, Lira, Masindi, Mbale, Mbarara, Mukono and Soroti. Specialized equipment for solid waste management was provided to the urban Local Governments in the towns of Busia, Tororo, Mityana and Gulu (Government of Uganda, 2015a), solid waste management is still a challenge even in these urban centres.

2.6.11 Degradation of the natural environment and urban ecosystems

Urbanization has negatively affected the natural environment, more especially the increased encroachment on critical ecosystems and natural resources like wetlands, urban forests and open/ green spaces, hilltops, river banks and lake shores. Degraded ecosystems affect water quality and supply, and other important functions like drainage, flood control and economic activities such as fishing, tourism and farming. The resulting environmental degradation makes urban areas highly vulnerable to natural hazards such as drought, floods, earthquakes and landslides. Urban populations rely heavily on biomass energy (charcoal and firewood) for cooking, which has accelerated the destruction of forest and woodland ecosystems in the countryside. The increased in motor vehicles and congestion in cities as well as industrialization have affected air quality through air pollution and as well water population which in adversely effect on the health of the people.

2.6.12 Gender equality in urban development

Gender equality and empowerment of women is a cross cutting issue. SDG 5 calls for achievement of gender equality and empower all women and girls. The GoU recognizes that the attainment of gender equality and women empowerment is a prerequisite for accelerated socioeconomic transformation. Significant progress has been made in strengthening gender equality and women empowerment (UN-Habitat, 2012) through the formulation of a gender responsive regulatory framework and institutionalization of gender planning in all sectors. As a result, Uganda moved from 43rd to 29th in the global gender gap ranking between 2008/09 and 2011/12.

However, gender inequalities still exist in urban areas especially regarding access to, control over and ownership of businesses and productive resources such as land and credit; with the women most disadvantaged. Further, there is limited employment of women in skill-based industries and this constrains further women's income potential (UN-Habitat, 2012). Women are also marginalized in skills development, access to financial resources, employment in non-agriculture sectors and inheritance rights, and only 27% of registered land (most of it in urban areas) is owned by women and less than 20% of women control the outputs and proceeds from their efforts (Twinomuhangi *et al.,* 2015). About 50% of women cite getting money as a problem for accessing health care, including reproductive health care.

UN Habitat (2012) observes that gender based violence against women living in the slum, though declining is still a major challenge. Women are often unable to negotiate safer sex due to lower status, economic dependence and fear of violence. Women bear the brunt of caring for sick family members and are more likely to be rejected, expelled from the family home and denied treatment, care and basic human rights if they fall sick. When data is disaggregated by age and sex, it shows that more women in urban areas are affected by HIV/AIDS than men, and moreover at a younger age than men (UN Habitat, 2012). Gender inequalities increase vulnerabilities of women and children to the impacts of climate change and must be addressed to achieve climate resilient urban development.

3. THE CLIMATE PROFILE: OBSERVED AND PROJECTED

3.1 Introduction

Addressing the climate change challenges faced by urban areas while at the same time enhancing sustainable urban development requires understanding of the current climate and future changes in climate. This chapter presents the climate profile of Uganda and the selected urban areas. The climate profile is presented in three sections: the observed climate, projected climate and climate change impacts.

3.2 Observed climate

3.2.1 Observed global climate

The IPCC Fifth Assessment Report (IPCC AR5) confirms that since the 1950s, the rate of global warming has been unprecedented compared to previous decades and millennia, resulting from increased GHG emissions from human activity (IPCC, 2013). Each of the last three decades has been warmer than all previous decades since 1850 and the first decade of the twenty-first century (2001-2010) has been the warmest since 1850. This irrefutable warming has been observed in nearly all regions of the world, including Africa, at various scales (World Bank Group, 2015).

The average temperature at the earth's surface is reported to have increased by about 1°C over the period 1901-2012. The most significant warming occurs on the land surface (from 0 to -75 meters): + 0.11°C per decade between 1971 and 2010 i.e. +0.44°C in less than 40 years. There is evidence of increased warming over land across Africa in the last 50-100 years with surface temperatures having increased by 0-2°C over the past 100 years (IPCC, 2013).

Confidence in precipitation change averaged over global land areas since 1901 is low prior to 1951 and medium afterwards. Averaged over the mid-latitude land areas of the Northern Hemisphere, precipitation has increased since 1901 (medium confidence before and high confidence after 1951). For other latitudes area-averaged long-term positive or negative trends have low confidence. Although most areas lack data on rainfall over the past century, where data is available, there are indications that rainfall patterns are changing with a decrease in average rainfall in parts of West Africa (25-30 mm per decade from 1950 – 2010, while some parts of Southern and Eastern Africa have experienced increase in average annual rainfall (5-10 mm) per decade in the same period.

Changes in many extreme weather and climate events have been observed since about 1950. It is very likely that the number of cold days and nights has decreased and the number of warm days and nights has increased on the global scale. It is likely that the frequency of heat waves has increased in large parts of Europe, Asia and Australia. There are likely more land regions where the number of heavy precipitation events has increased than where it has decreased. The frequency or intensity of heavy precipitation events has likely increased in North America and Europe. However, there is a general lack of data for Africa.

3.2.2 Observed climate for Uganda

The climate change trends observed globally are confirmed in Uganda:

Increased temperature. In Uganda, observed averages in annual near-surface temperatures are around 21°C. The observed temperatures between 1900 and 2009 shows an increase in average annual temperature of between 0.8°C - 1.5°C with typical rates of warming around 0.2°C per decade. The period 1960 – 2008 has been progressively warmer. It was also found that the

nights are warming faster compared to the days (Ministry of Water and Environment, 2015a). For example, during the period 1960-2008, the frequency of hot days increased by 20% and the frequency of cold days decreased across all months, except December, January and February (McSweeny *et al,* 2010).

Observed rainfall. The country has not experienced any statistically significant changes in annual rainfall over the past 60 years (USAID, 2013, World Bank, 2015a, World Bank Group, 2015). Observed annual rainfall totals for Uganda vary from 500 mm to 2800 mm, with an average of 1180 mm. The observed rainfall for 1900–2009 indicates that for the period 2000–2009, rainfall has been on average about 8% lower than rainfall between 1920 and 1969. Although the June–September rainfall appears to have been declining for a longer period, the March–June decline has only occurred recently. Three long epochs of below-normal rainfall occurred between 1940 and 1960, around the 1970s and again around the 1980s and 1990s. Above-normal rainfall periods occurred during the early 1960s and late 1970 and late 1990s. It is interesting to note that episodes of exceptionally high rainfall totals during the 1960s and 1970s were preceded by relatively long low rainfall periods (Ministry of Water and Environment, 2015a).

Extreme weather events: It is estimated that 90% of Uganda's natural disasters are climate change related (Ministry of Water and Environment, 2015a). The country has been repeatedly affected by extreme events such as droughts and floods. Available evidence suggests that droughts in Uganda are becoming more frequent and more severe (IGAD, 2010). For example, between 1991 and 2000, Uganda experienced seven severe droughts. Over 5 million people in Uganda have been affected by climate related disasters since 1979 - over 4 million have suffered severe droughts, about 1 million affected by floods. The western, northern, and northeastern regions have been experiencing more frequent and longer-lasting droughts than seen historically. Climate related disasters have negatively affected agriculture. For example, an average of 800,000 hectares of crop is destroyed annually by climate-related effects, resulting in losses in excess of UGX120 billion. During the 1997/1998 floods, there was a 60 per cent drop in coffee exports and suspension of tea estates operations in eastern parts of the country, while 300 hectares of wheat were lost in Kapchorwa District due to these floods. In September 2010, flood disasters hit the Teso sub-region, leading to rotting cassava, sweet potato tubers and groundnuts worth UGX8 billion. Economic losses resulting from transport accidents, fires and other climate related disasters have been estimated at UGX 50 billion annually.

Table 5: Summary of Past Climate trends globally and for Uganda

	Temperature	Precipitation	Extreme weather events
Global	• Average temperature on the surface: + 1°C (1901-2012) • Annual mean temperature of sea surface: + 0.44°C in less than 40 years	• No clear trends	• Global mean sea level rise over the period 1901 to 2010 - 0.19 [0.17 to 0.21]m; i.e. 1.7 mm/year; • Increase in sea level almost twice as fast since 1993 (3.2mm/year)
Uganda	• Average temperatures + 0.8 - 1.5°C (1900 -2009) i.e. warming of about 0.2°C per decade.	• Between 2000 and 2009, rainfall has been on average about 8% lower than rainfall between 1920 and 1969.	• 90% of Uganda's natural disasters are climate change related. • Since 1990, the magnitude and frequency of droughts and floods has increased with over 5 million people directly affected.

Source: KCCA, 2015

3.2.3 Observed climate for selected urban centres

Mean annual historical temperature

Analysis of inter-annual variability (year to year variability) of mean annual temperature shows that over the period of 1975 – 2005 (30 years), annual mean values of temperature did not change much from year to year as depicted by low values of the coefficient of variability (CV) as illustrated in Table 6. The inter annual variability is almost the same in all the regions of the country with central region varying between 1 to 2%, western region 0.9 to 1.3%, Eastern region 1.1 to 1.3% and Northern region 0.9 to 1.8%. These low values of CV for temperature are expected because Uganda lies in the tropics where temperatures do not vary by large values throughout the year.

In terms of trends all the towns show increasing trends of annual mean temperature in the period 1975 to 2005 and these trends are highly significant as depicted by P-values less than 0.05[2] (Table 7)

Table 6: Variability of historical annual mean Temperature in selected towns 1975-2005

Urban Area	Region	Annual Mean Temperature	SD	CV (%)
Kampala	Central	22	0.22	1.0
Entebbe	Central	21.5	0.42	2.0
Masaka	Central	20.9	0.21	1.0
Mukono	Central	22	0.22	1.0
Nakasongola	Central	22.8	0.26	1.1
Fort Portal	Western	19.5	0.20	1.0
Kabale	Western	17.6	0.24	1.3
Kasese	Western	23	0.27	1.2
Mbarara	Western	20.4	0.21	1.0
Kiruhura	Western	21.3	0.19	0.9
Mpondwe -Lhubiriha	Western	23	0.27	1.2
Jinja	Eastern	22.1	0.23	1.1
Kamuli	Eastern	22.4	0.25	1.1
Mbale	Eastern	22.6	0.35	1.5
Malaba	Eastern	23	0.36	1.6
Arua	Northern	22.8	0.21	0.9
Gulu	Northern	23.2	0.25	1.1
Lira	Northern	23.1	0.30	1.3
Moroto	Northern	23	0.33	1.5
Amudat	Northern	22.8	0.42	1.8
Paidha	Northern	22.7	0.23	1.0

Total annual historical rainfall

In terms of variability, annual rainfall was found to be highly variable as compared to temperature in the period of 1975 to 2005 (Table 8). Moroto has the highest variability in its annual rainfall with a CV of 21.6%, while Kasese and Mpondwe-Lhubiriha have the lowest variability of 9% in the same period. There are no major differences in rainfall variability across regions, as Central region's CV values range from 10.2 to 14.6%, Western region 9.9 to 16%, Eastern region 10 to 12.5%, and the Northern region 10.6 to 21.6%.

2 The trend analysis of temperature was at a significance level of 5%.

In terms of trends, no urban areas is showing any significant change at 5% level in total annual rainfall in the period 1975 to 2005 because the P-Values are all greater than 0.05 (Table 9). However, Gulu, Kabale, Kasese, Mbarara and Mpondwe-Lhubiriha show fairly decreasing trends in total annual rainfall in the period. The rest of the urban areas show a fairly increasing trend in annual rainfall.

In regional analysis, all urban centres in the Central and Eastern regions show fairly increasing trends, while four urban areas in western region (Kabale, Kasese, Mbarara and Mpondwe-Lhubiriha) show decreasing trends. The urban centres in the Northern region show fairly increasing trends apart from Gulu, which shows fairly decreasing trend.

Table 7: Trend analysis of historical annual mean temperature for the selected urban centres 1975 to 2005)

Urban Area	Region	R-Square	slope	P-Value	Significance at 5%
Kampala City	Central	0.428	0.018	0.0000	Significant
Entebbe	Central	0.421	0.013	0.0000	Significant
Masaka	Central	0.467	0.019	0.0000	Significant
Mukono	Central	0.428	0.018	0.0000	Significant
Nakasongola	Central	0.375	0.019	0.0001	Significant
Fort Portal	Western	0.494	0.019	0.0000	Significant
Kabale	Western	0.445	0.020	0.0000	Significant
Kasese	Western	0.477	0.023	0.0000	Significant
Mbarara	Western	0.486	0.020	0.0000	Significant
Kiruhura	Western	0.494	0.018	0.0000	Significant
Mpondwe-Lhubiriha	Western	0.447	0.023	0.0000	Significant
Jinja	Eastern	0.389	0.018	0.0001	Significant
Kamuli	Eastern	0.386	0.019	0.0001	Significant
Mbale	Eastern	0.271	0.020	0.0013	Significant
Malaba	Eastern	0.238	0.019	0.0029	Significant
Arua	Northern	0.472	0.020	0.0000	Significant
Gulu	Northern	0.370	0.018	0.0001	Significant
Lira	Northern	0.283	0.018	0.0010	Significant
Moroto	Northern	0.172	0.015	0.0132	Significant
Amudat	Northern	0.217	0.019	0.0048	Significant
Paidha	Northern	0.465	0.021	0.0000	Significant

Table 8: Variability of historical annual total rainfall in selected towns 1975-2005

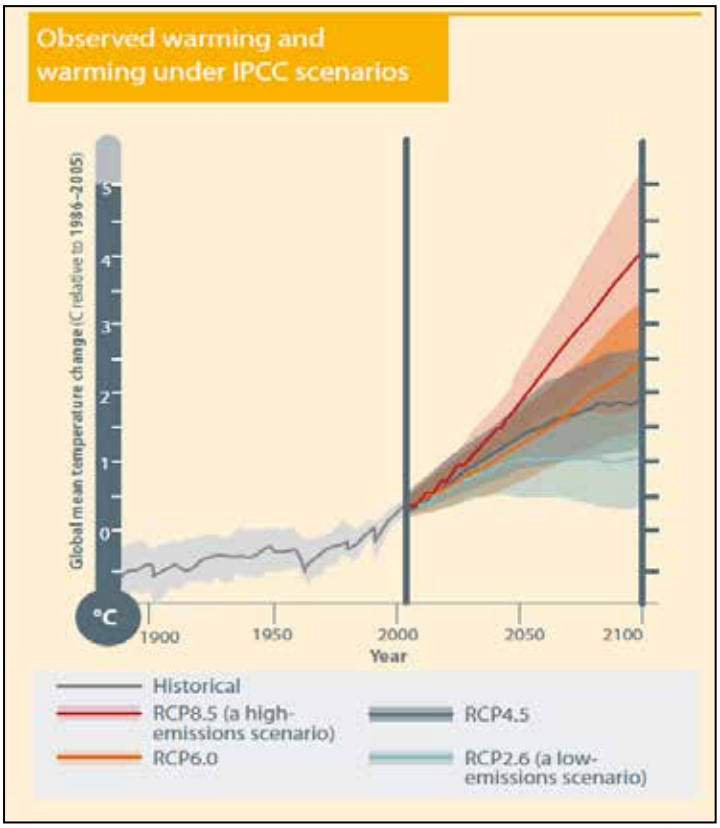
Urban Area	Region	Mean Annual Rainfall	SD	CV (%)
Kampala	Central	1390	155.9	11.2
Entebbe	Central	1605	234.0	14.6
Masaka	Central	1061	115.3	10.9
Mukono	Central	1390	155.9	11.2
Nakasongola	Central	1058	108.3	10.2
Fort Portal	Western	1359	217.8	16.0
Kabale	Western	1204	173.6	14.4
Kasese	Western	969	95.5	9.9
Mbarara	Western	1051	128.5	12.2

Urban Area	Region	Mean Annual Rainfall	SD	CV (%)
Kiruhura	Western	987	107.7	10.9
Mpondwe-Lhubiriha	Western	969	95.5	9.9
Jinja	Eastern	1275	143.1	11.2
Kamuli	Eastern	1188	118.2	10.0
Mbale	Eastern	1508	188.8	12.5
Malaba	Eastern	1306	148.9	11.4
Arua	Northern	1327	160.5	12.1
Gulu	Northern	1396	147.7	10.6
Lira	Northern	1345	155.8	11.6
Moroto	Northern	875	188.7	21.6
Amudat	Northern	1167	218.4	18.7
Paidha	Northern	1370	145.2	10.6

Table 9: Trend analysis of historical annual total rainfall for the selected towns from 1975 to 2005

Urban Area	Region	R-Square	Slope	P-Value	Significance at 5%
Kampala	Central	0.002	0.657	0.803	Not Significant
Entebbe	Central	0.007	1.948	0.622	Not Significant
Masaka	Central	0.031	1.966	0.316	Not Significant
Mukono	Central	0.002	0.657	0.803	Not significant
Nakasongola	Central	0.007	0.891	0.626	Not Significant
Fort Portal	Western	0.000	0.223	0.952	Not Significant
Kabale	Western	0.010	-1.717	0.559	Not Significant
Kasese	Western	0.017	-1.199	0.458	Not Significant
Mbarara	Western	0.003	-0.710	0.743	Not Significant
Kiruhura	Western	0.057	2.547	0.167	Not Significant
Mpondwe-Lhubiriha	Western	0.017	-1.199	0.458	Not Significant
Jinja	Eastern	0.000	0.288	0.905	Not Significant
Kamuli	Eastern	0.000	0.080	0.968	Not Significant
Mbale	Eastern	0.055	4.392	0.174	Not Significant
Malaba	Eastern	0.031	2.547	0.314	Not Significant
Arua	Northern	0.019	2.153	0.429	Not Significant
Gulu	Northern	0.026	-2.303	0.358	Not Significant
Lira	Northern	0.013	1.736	0.510	Not Significant
Moroto	Northern	0.008	1.613	0.613	Not Significant
Amudat	Northern	0.003	1.197	0.745	Not Significant
Paidha	Northern	0.000	0.024	0.992	Not Significant

3.3 Projected climate



It is also projected that many currently observed climate phenomena are likely to become more pronounced in the future (World Bank Group, 2015). The IPCC conducts climate assessments and projections at regular intervals using different models of the climate system, as well as economic and demographic studies, representing a wide range of possible climate changes. Climate simulations take into account many factors, distributed in two groups:

- Natural factors - volcanic eruptions, solar activity, etc;
- Anthropogenic factors - emission of greenhouse gases (GHG), aerosols, etc.

Figure 6: Observed warming and warming under IPCC scenarios (Source: CDKN, 2014)

3.3.1 Projected global climate

The IPCC AR5 confirms that warming will continue depending on the level of GHG emissions in the 21st Century (IPCC, 2013). Regardless of future emissions, further warming is expected due to past emissions and inertia in the climate system (CDKN, 2014). In assessing future climate change, the IPCC AR5 presents four scenarios, known as Representative Concentration Pathways (RCPs) - see Figure 6). The scenarios show the result of different levels of emissions of GHG, from the present day to 2100, on global warming. In all scenarios, carbon dioxide concentrations are higher in 2100 than they are today. The low-emissions scenario assumes substantial and sustained reductions in greenhouse gas emissions. The high-emissions scenario assumes continued high-emissions. The two intermediate scenarios assume some stabilization in emissions (IPCC, 2013; CDKN, 2014).

Projected rise in temperatures: The average surface temperature of the planet will increase by the end of the 21st Century from 0.3 to 4.8°C depending on the GHG emission scenarios over the period 1986-2005. This warming will continue after 2100.

During this century, temperatures on the African continent are likely to rise more than land areas. Under the high emission scenarios average temperature are likely to rise more than 2°C over most of the continent by the middle of the century and rise more than 4°C by the end of the century. Under the low emission scenario, temperature could rise by less than 2°C over the century.

In the Eastern Africa region, projections for medium to high emissions scenarios indicate that maximum and minimum temperatures over equatorial East Africa will rise and that there will be warmer days compared to the baseline by the middle and end of this century. Climate models show warming in all four seasons over Ethiopia, which may result in more frequent heat waves.

Projections on rainfall: Projections on rainfall are less certain than those for temperature. Most of the areas on the African continent do no show changes in average annual rainfall under low emission scenarios. However, a decrease in average annual rainfall could be experienced over areas in Southern Africa under high emissions scenarios but the Central and Eastern parts of Africa are likely to experience increase in average annual rainfall under the high emission scenarios.

Stern (2006) estimates that the costs of the impacts of extreme weather alone could reach 0.5 - 1% of world GDP per annum by the middle of the century, and will keep rising if the world continues to warm. With 5-6°C warming - which is a real possibility for the next century - existing models that include the risk of abrupt and large-scale climate change, estimate an average 5-10% loss in global GDP, with poor countries suffering costs in excess of 10% of GDP. Achieving these deep cuts in emissions will have a significant cost. The Review estimates the annual costs of stabilization at 500-550ppm CO2 e to be around 1% of GDP by 2050 - a level that is significant but manageable. Costs of mitigation of around 1% of GDP are small relative to the costs and risks of climate change that will be avoided.

3.3.2 Projected climate for Uganda

Global climate models (GCMs) have been used to simulate Uganda's future climate. The current warming trend is projected to continue with some variations across regions, while annual rainfall is projected to become more variable with more frequent and intense rainfall extremes. (World Bank Group, 2015). Four major climate change projection namely DEWPoint (2012), USAID (2013), CDKN and Ministry of Water and Environment, 2014) and World Bank Group (2015) have been conducted. The CDKN study in particularly has used the IPCC AR5 projections with a grid box distribution of 14 x 14 = 196 over Uganda. Projected near-surface temperatures are in the order of +2°C in 50 years from present, and in the order of +2.5°C in 80 years from present under the RCP 4.5, and could increase by between 4 – 6°C under RCP 8.5 (see Figure 7).

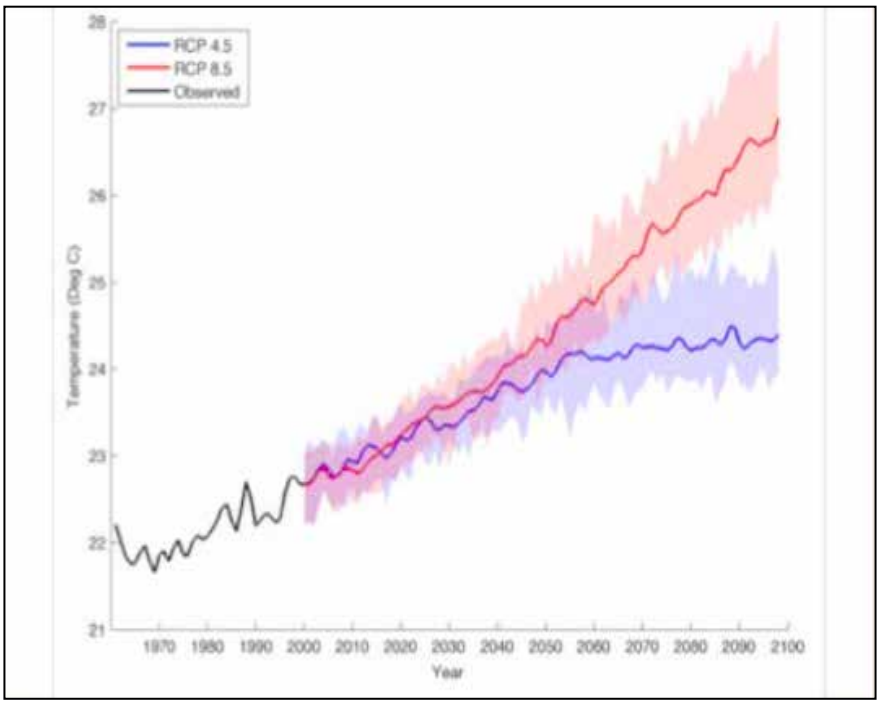


Figure 7: Annual historical (black) and projected (blue and red) temperature spatially averaged across Uganda (Source: World Bank Group, 2015)

Temperatures are expected to rise more during the MAM and JJA seasons in comparison to the DJF and MAM seasons. A lower temperature increase of about 1°C is expected for Lake Victoria. The studies are in agreement that projected annual rainfall totals are expected to differ little from what is presently being experienced, with projected changes within a range of less than plus or minus 10% from present rainfall. However, less rainfall is expected to occur over most of Uganda, with slightly wetter conditions over the west and northwest. Rainfall totals might drop significantly over Lake Victoria (where Kampala city is situated) - 20% from present. What is significant on a seasonal time scale is the projected increase in seasonal rainfall for the DJF season (up to100% from present), which is indicative of a longer wet season that extends from SON towards DJF.

Under the more extreme climate change (RCP8.5), projected annual rainfall total changes are very similar to that of the RCP4.5 projections, and therefore still close to what is currently observed. On a seasonal time scale the MAM and JJA seasons might expect slightly less rainfall, while the percentage increase in DJF rainfall, as in the RCP4.5 projections, is again very significant. A similar drop (-20%) over Lake Victoria is projected.

Projected near-surface temperatures are in the order of +3°C in 50 years from present, and in the order of +5°C in 80 years from present. Seasonal temperatures are expected to increase between +2°C and +3°C for DJF, MAM and JJA in 50 years from present, with a slightly lower increase for SON. In 80 years from present, temperatures might rise as much as +5.5°C during the JJA season (currently the coolest season), while increases of between +4°C and +5°C are expected for the seasons DJF, MAM and SON. Smaller changes are expected over Lake Victoria. Table 10 below gives a summary of those results.

Table 10: Temperature and Rainfall projections under RCP 4.5 and RCP 8.5 for Uganda.

Parameter	RCP 4.5	RCP 8.5
Annual temperature changes from the median	In +50 years to present: +1.5°C to +2°C in most continental parts of Uganda In +80 years from present: +2°C to +2.5°C in most of Uganda.	In +50 years to present: +2°C to +3°C in most continental parts of Uganda In +80 years from present: +4°C to +5°C in most of Uganda.
Annual rainfall changes from the median	In both +50 and +80 years: -5 mm (mostly in the northern half) to -10mm per month (mostly in the southern half). Up to -70mm per month over Lake Victoria.	In both +50 and +80 years: -10mm to -20mm (mostly in the northern half) to -30mm per month (mostly in the south). Over -100mm per month over Lake Victoria.

Source: KCCA, 2015

The decrease in rainfall in most of Uganda, combined with a significantly wetter DFJ season, will result in significantly drier conditions for the rest of the year (longer wet season that extends from SON towards DJF). This is to combine with significant temperature increases, especially during the MAM and JJA seasons.

Overall, those changes will require a number of adaptation strategies. A significant drop of total rainfall over Lake Victoria (-20% from present), combined with about 1°C temperature increase will impact the lake water level. The increased warming, with high average air temperatures, will most likely amplify water stress and increase the impact of water shortages. Warming temperatures are likely to adversely affect agriculture production, which is an important economic activity for Uganda.

3.3.3 Projected climate for selected regions and urban centres

Mean annual temperature projections

Mean annual temperature is projected to increase in all the selected urban centres with RCP 4.5 giving incremental values of between 0.6 to 0.9°C for the 2020s and RCP 8.5 giving values of 0.8 to 1°C compared to the baseline climate of 1975-2005 (Table 10). Kabale has the highest increment in annual temperature of 0.9°C under RCP4.5, while Moroto has the highest increase of 1°C under RCP 8.5 for the 2020s decade. An average increase of 0.2°C is observed in the projections per decade in most of the towns in both RCP 4.5 and RCP 8.5 with highest projections for Kabale reaching 1.3°C under RCP 4.5 and Moroto reaching 1.5°C under RCP 8.5 by the 2040s.

A regional analysis of the projections does not show any significant changes in mean annual projections per decade in the four regions of Uganda (Figure 8). However, urban centres in the northern region will be slightly warmer than urban centres in the other regions by between 0.1°C and 0.2°C, especially Lira and Moroto. Climate change projections for each of the towns are presented in Annex 2.

Table 10: Mean annual Temperature Projections of selected towns in Uganda

Urban Area	Region	Historical	2020s		2030s		2040s	
			RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
Kampala City	Central	22	0.6	0.8	0.9	1	1.1	1.3
Entebbe	Central	21.5	0.8	0.8	0.9	1	1	1.4
Masaka	Central	20.9	0.7	0.8	1	1.1	1.1	1.3
Mukono	Central	22	0.6	0.8	0.9	1	1.1	1.3
Nakasongola	Central	22.8	0.7	0.8	1	1.1	1.2	1.4
Fort Portal	Western	19.5	0.8	0.9	1	1.1	1.2	1.4
Kabale	Western	17.6	0.9	0.9	1	1.2	1.3	1.3
Kasese	Western	23	0.8	0.8	1	1.1	1.2	1.3
Mbarara	Western	20.4	0.7	0.8	0.9	1	1.1	1.3
Kiruhura	Western	21.3	0.8	0.9	1	1.1	1.2	1.3
Mpondwe-Lhubiriha	Western	23	0.8	0.8	1	1.1	1.2	1.3
Jinja	Eastern	22.1	0.7	0.8	0.9	1	1.1	1.3
Kamuli	Eastern	22.4	0.7	0.8	0.9	1	1.1	1.3
Mbale	Eastern	22.6	0.8	0.8	1	1.1	1.2	1.4
Malaba	Eastern	23	0.7	0.8	1	1.1	1.1	1.3
Arua	Northern	22.8	0.8	0.9	1.2	1.2	1.2	1.4
Gulu	Northern	23.2	0.8	0.9	1	1.1	1.2	1.4
Lira	Northern	23.1	0.8	0.9	1	1.2	1.2	1.5
Moroto	Northern	23	0.8	1	1.1	1.2	1.2	1.5
Amudat	Northern	22.8	0.8	0.9	1	1.1	1.1	1.4
Paidha	Northern	22.7	0.8	0.9	1	1.2	1.2	1.4

Mean annual Rainfall projections

Unlike temperature, mean annual rainfall projections do not show a clear trend of either increasing or decreasing in the future period considered (Table 11). Most urban centres especially in the Eastern region show slight increases in total annual rainfall of between 5% and 16% compared to the 1975-2005 baseline for the 2020s period under RCP 4.5. However, Lira, Arua and Nakasongola show slightly reduced rainfall of between 1 and 3% compared to the base line. For the same period under RCP 8.5 most of the urban centres showed decreasing annual rainfall apart from Mbale and Malaba which show a slightly increase in annual rainfall of about 2% in the 2020s. The decades of 2030s and 2040s do not show a particular trend in rainfall with both decrease and increase seen in the projections under both scenarios.

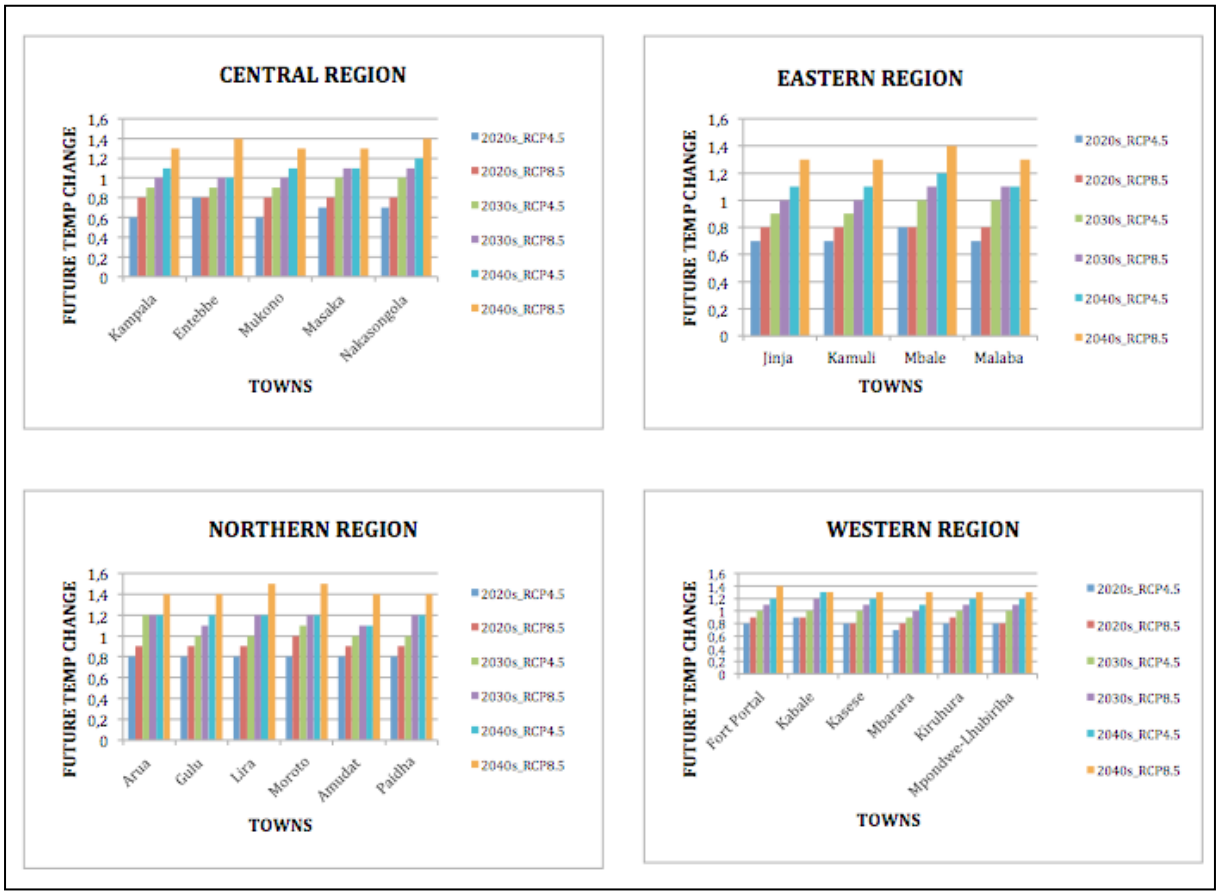


Figure 8: Mean annual temperature projections of Ugandan urban centres grouped in the four major four regions

Table 11: Mean annual Rainfall Projections for the selected towns of Uganda

Urban Area	Region	Historical	2020s		2030s		2040s	
			RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5
Kampala City	Central	1390	5.2	-1.3	3.9	2.5	-3.8	10.1
Entebbe	Central	1605	7.7	0.2	5.1	3.7	-1.4	12.6
Masaka	Central	1061	2.9	-1.8	-1.0	3.4	-3.2	5.2
Mukono	Central	1390	5.2	1.3	3.9	2.5	-3.8	10.1
Nakasongola	Central	1058	-2.5	-8.0	-3.3	-1.1	-9.6	-3.3
Fort Portal	Western	1359	0.7	-8.8	-3.2	0.3	-1.3	2.4
Kabale	Western	1204	5.4	-3.9	1.4	5.8	0.1	6.5

Kasese	Western	969	7.3	-0.7	0.9	2.6	2.4	5.8
Mbarara	Western	1051	4.2	0.3	5.2	6.4	1.8	10.3
Kiruhura	Western	987	2.5	-4.8	0.1	3.1	0.3	2.1
Mpondwe-Lhubiriha	Western	969	7.3	-0.7	0.9	2.6	2.4	5.8
Jinja	Eastern	1275	1.3	-3.9	0.8	2.7	-3.4	6.4
Kamuli	Eastern	1188	1.5	-3.9	-2.1	0.2	-3.5	-0.2
Mbale	Eastern	1508	12.7	1.8	-1.0	9.9	-5.2	3.4
Malaba	Eastern	1306	15.8	2.0	8.2	13.5	1.7	9.6
Arua	Northern	1327	0.2	-5.5	-0.7	0.3	-1.4	-0.8
Gulu	Northern	1396	-1.5	-10.3	-2.5	-1.1	-6.4	-4.0
Lira	Northern	1345	-0.2	-7.7	-0.9	2.7	-4.6	-4.8
Moroto	Northern	875	2.3	-8.2	-1.0	6.4	-1.0	-4.3
Amudat	Northern	1167	14.7	-1.2	-3.1	12.2	-0.1	8.1
Paidah	Northern	1370	9.8	-3.6	4.4	5.8	9.2	9.8

A regional analysis (Figure 9) shows that northern region urban centres of Arua, Gulu, Lira and Moroto are projected to have a decrease in annual rainfall of between 1 and 10% by the year 2050 while Amudat and Paidha will have slightly increased annual rainfall in the same period.

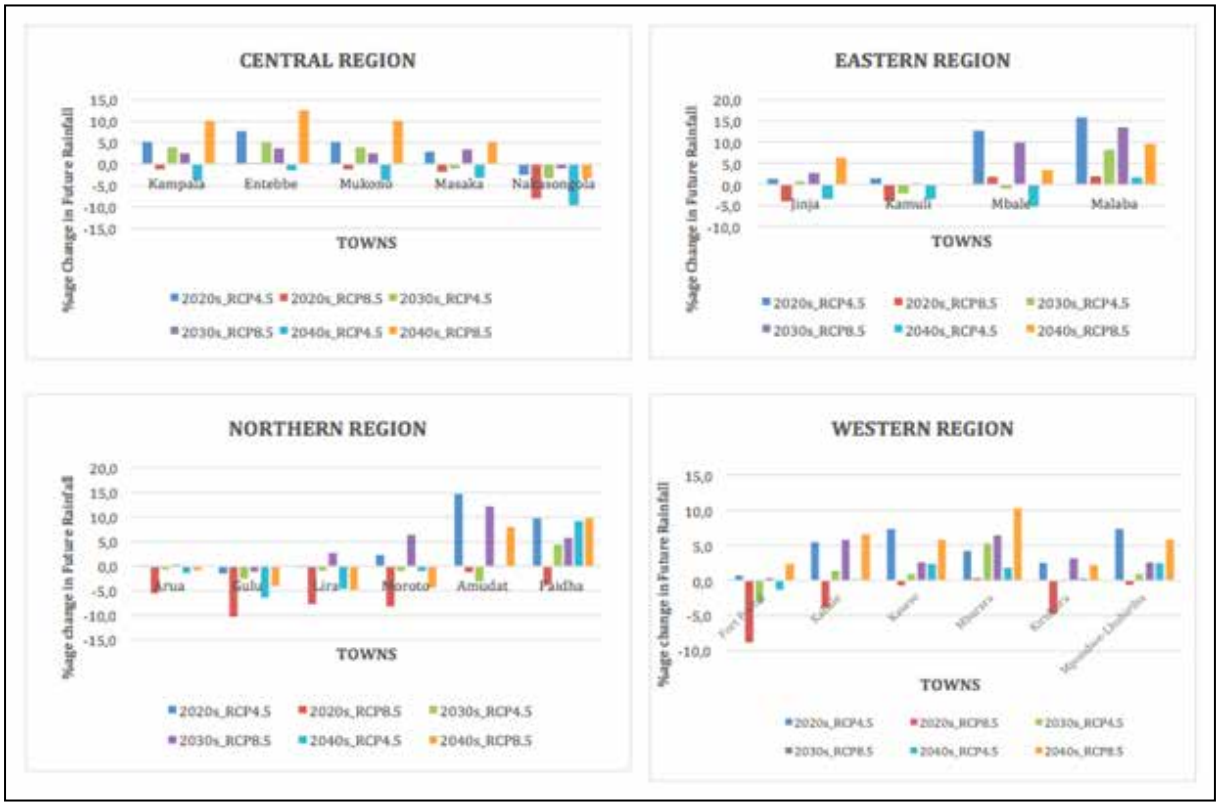


Figure 9: Mean annual rainfall projections of Ugandan towns grouped in four regions

In the central region, the urban centres of Kampala and Entebbe will have increased annual rainfall while Nakasongola will have reduced rainfall. Masaka does not show any significant annual rainfall changes in the future period. In the Western region, Kabale, Kasese, Mbarara and Mpondwe-Lhubiriha show fairly increased annual rainfall by 2050, while Fort Portal and Kiruhura show decreased annual rainfall in the same period. In the Eastern region, Mbale and Malaba show increased annual rainfall by 2050 while Jinja and Kamuli show slightly decreased rainfall by 2050 compared to 1975-2005 baselines. The projections for individual towns are presented in Annex 2.

4. IMPACTS, VULNERABILITIES AND ADAPTATION IN URBAN AREAS

4.1 Introduction

Building the resilience of urban systems to climate change requires, among others, increased awareness and knowledge of the climate system and its impacts as well as the vulnerabilities and appropriate adaptation options. In Chapter 3, we discussed the observed climate trends and projected climate futures. In this chapter, the discussion focuses on climate change impacts (risks, hazards and disasters) and vulnerabilities specific to Uganda's urban territories. These issues are very instrumental to building adaptive capacity and disaster preparedness systems in urban areas.

4.2 Impacts of climate change on urban areas

Climate change poses risks to urban systems and urban residents. According to IPCC (2014) the risks arise from climate related hazards, and the vulnerability of exposed societies, communities and systems: in terms of livelihoods, infrastructure, ecosystems services and governance. Effective measures to adapt change and reduce risks associated with climate change can address the three aspects of risk i.e. hazard, exposure and vulnerability (See figure 10).

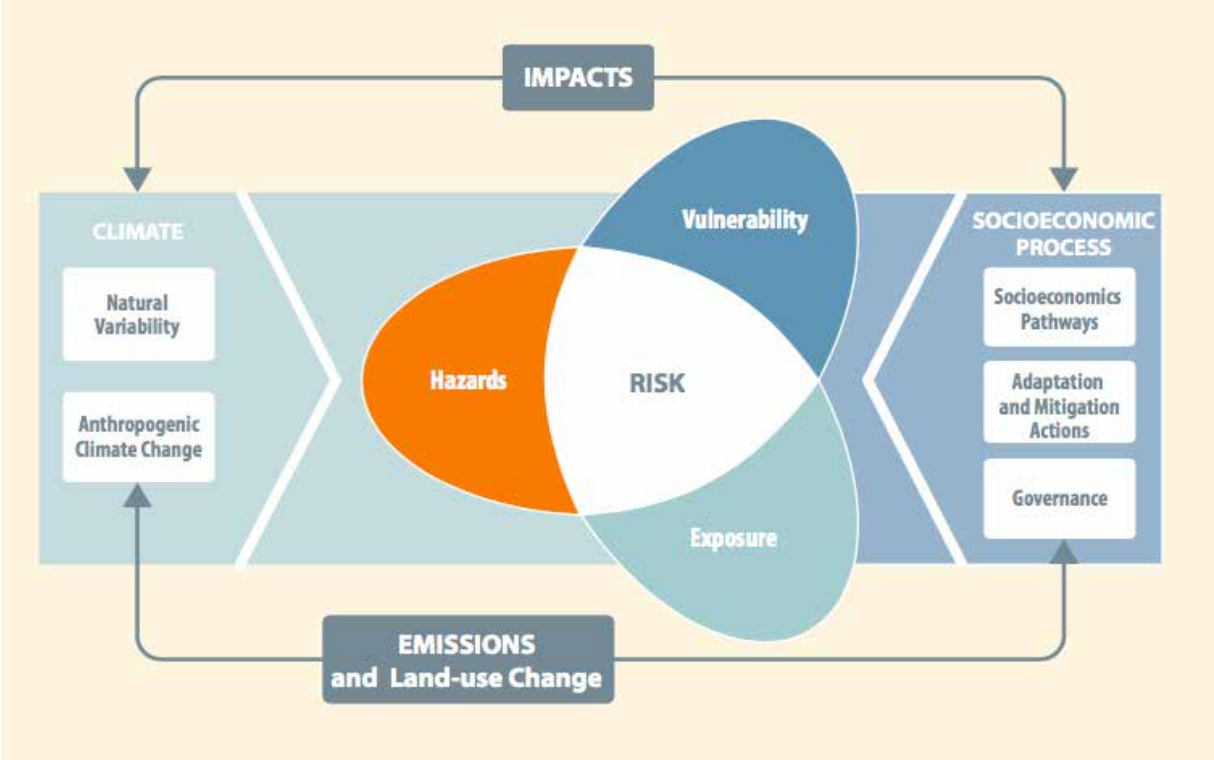


Figure 10: Illustration of the core concepts of climate change risks (Source: IPCC, 2014)

4.2.1 Extreme temperatures

As already mentioned in chapter 3, Uganda (and the urban areas therein) is already experiencing increasing warming, with this warming occurring in the last decades, especially since 1960. The observed warming is projected to continue with temperatures rising by 2-6^{0}C under different emission scenarios. This implies that, extreme temperatures and heat waves are likely to be experienced in the future. There is a likelihood of more hot days, hot nights and hotter days, and fewer cold days and cold nights in the future. Extreme temperatures and heat waves are likely to

increase evapotranspiration across the country. These will reduce soil moisture, water table and available surface water, which will affect agriculture and water availability.

4.2.2 Extreme rainfall and floods

The most significant climate change impact on urban areas is increased variability in rainfall with more frequent and intense rainfall extremes. The increased intense rainfall results in flooding in most of Uganda's urban areas. With extreme rainfall events projected to become more common in all parts of the country, increased flooding will be experienced which will destroy infrastructure of housing, roads, culverts, drainage systems and water supply; affecting the livelihoods, housing and health of urban residents. Although all the studied urban centres reported flooding as challenge, it is more pronounced in Kampala city (and the Greater Kampala) and Kasese Municipality.

The UN Desinventar database indicates that in the period 1993-2014 (20 years), there were 11 severe flooding events in Kampala city. The cost of inaction for the city is very high, with annual estimates for the cost of damages from flooding rising from USD 1-7 million in 2013 to USD 33-102 million by 2050 (Twinomuhangi and Monkhouse, 2015). In Kasese, the 2013 floods caused severe damage to infrastructure and human life and health (see Table 12) The costs of repairing major bridges and road networks were estimated at UGS 35 billion (USD 13.7 million) (MK News Link Agency, 2014). Damage to the hospital included the loss of the mortuary, the paediatrics ward and an X-ray machine, for which funds were requested from the Department of Health (The Insider, 2013).

Table 12: Major impacts of the May 2013 Kasese floods

Table 7: Major impacts of Kasese floods in May 2013

Impact type	Description
Mortality	10 lives lost
Water borne disease	Increased risk of water borne disease due to water supply damage
Displacement	25,445 forced from homes, Red Cross distributed 3300 shelter and NFI kits
Housing	Severe damage to almost all housing units in Bulembia district and Kilembe town
Infrastructure:	
Bridges	19 bridges washed away
Hospitals	Damage to Kilembe Mines hospital, including loss of equipment.
Sewage treatment	Damage to sewage treatment
Water supply	Destruction of water supply systems
Energy	Three hydropower plants on River Mubuku affected

Source: Baastel (2015a).

The slums and informal settlements, where the urban poor live are prone to increased flush floods. In addition, most of the slums and informal settlements in Kampala and the large towns do not have access to piped water; their main source of water is natural springs, wells and boreholes. During flooding, most of these water sources get contaminated due to the poor sanitary conditions, compromising the health of these poor communities. This reduces availability of safe and clean water.

However, whereas almost all the urban areas under the study reported severe cases of flooding over the recent decades, much of the flooding is driven by poor physical planning and urban governance and the related: inadequate drainage systems, encroachment of wetland ecosystem and green spaces and poor solid waste management systems. For example, in Kampala city the development of housing on hill tops results in clearing of natural vegetation. This reduces infiltration of rainfall and increases runoff. On the other hand, the location of human settlements in low-lying valleys and wetlands increases exposure and vulnerability. The encroachment of the wetlands has left no room for storm water to drain, reducing its absorption capacity and increasing run off. In addition, it has contributed to the silting of Lake Victoria through Nakivubo channel and its tributaries and the loss of carbon sinks. UN-Habitat (2013) found that the number and size of buildings increased in all the divisions of the city in the period 2004-2010: in total the building roof area increased by 262% in the period, contributing to the imperviousness of the land surface and, therefore, to runoff and a higher risk of flash flooding.

4.2.3 Droughts

The implication of changing rainfall trends/patterns, and more especially increased droughts, will increasingly affect urban areas in Uganda. In the first place, the increased frequency and magnitude of droughts will affect agriculture and food security. Droughts will reduce agricultural productivity in the hinterland as well as urban agriculture affecting food supply resulting in rising food prices and insecurity. The urban poor who cannot afford the high food process will be affected most. Droughts coupled with extreme temperatures will affect urban water supply. For example Arua, Kampala, Gulu, Kasese, Mbarara, Mondwe-Lhubiriha, Moroto, Nakasongola towns are already experiencing severe water availability challenges, with water supply affected in the dry seasons when the water sources run dry. In most of these urban centres, alternative water supply sources to the existing sources, such as water harvesting is very limited.

Secondly, the main source of electricity for Uganda is hydro and droughts could reduce water that could affect energy supply. The current power system is very exposed to the effects of climate change and most urban areas do not have alternative forms of generating electricity, particularly renewable ones, such as solar panels. For example, water reduction in Lake Victoria has reduced in the past affecting electricity supply. In West Nile electricity supply from the Nyagak power station is not stable due to water fluctuations. The same challenge is experienced with the Mpanga hydropower station on river Mpanga in western Uganda.

4.3 Vulnerability of urban systems to impacts of climate

Understanding vulnerability is a vital part of the climate change adaptation planning process. The IPCC defines vulnerability as 'the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity" (IPCC, 2007). In this section exposure, sensitivity, and adaptive capacity of Uganda's urban areas to climate change risks is assessed in order to understand how they are vulnerable or resilient to the impacts of climate change.

The vulnerability of Uganda's urban systems to climate change risks and disasters are not uniform but vary because of the differences in and changing socio-economic, infrastructural, economic, environmental, and governance circumstances. This study mainly used the HIGS framework to assess vulnerabilities and the dimensions of vulnerability and adaptation considered are summarized in Figure 11.

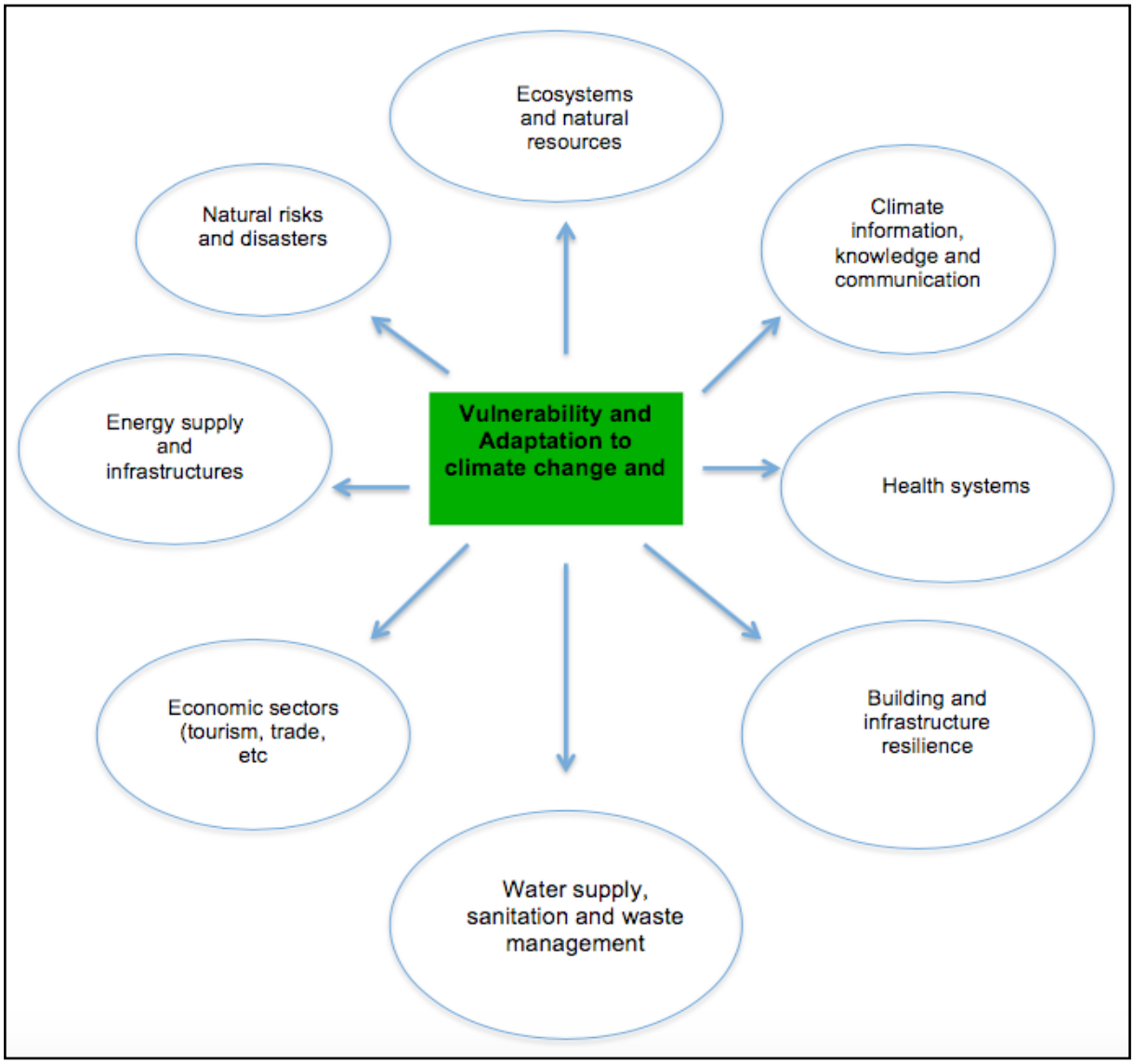


Figure 11: Dimensions of vulnerability and adaptation to climate change in urban systems

4.4 Infrastructure vulnerabilities (transport, energy, water and sanitation, public building and critical facilities)

4.4.1 Energy generation and supply

Energy is essential in the achievement of sustainable urban development and socio-economic transformation of Uganda. Energy security is a core issues for urban economies as most of the urban infrastructure, activities, services and livelihoods depend on energy. For urban areas to be attractive and productive, the availability, reliability and affordability of electricity supply is a strategic matter. The GoU's had prioritised to increase electricity generation and access, and in particular increased use of renewable energy. The NCCP policy and the Uganda GGDS also emphasize the need for greening the country's energy as this will deliver multiple benefits i.e.

increase energy security, climate resilient energy sector, reduced GHG emissions, improved human health, increased investments, job creation, and overall socio-economic transformation and poverty reduction.

Energy generation in Uganda is directly impacted by climate variability. Uganda's main source of electricity (hydro-power) requires significant amounts of water and is thus highly vulnerable. However, water availability is a function of climatic conditions, although other non-climatic drivers like water management and development are important (World Bank Group, 2015). Reduced water levels on Lake Victoria in the last decade have reduced hydropower generation by about 100MW (Energypedia.info: https://energypedia.info/wiki/Uganda_Energy_Situation#Energy_demand). Equally hydropower generation on River Mpanga in western Uganda (Ministry of Water and Environment, 2015a) and Nyagak river in West Nile have been affected by fluctuation in water levels in the rivers. There is a high possibility that hydropower potential will decrease due to the combined effect of the predicted reduction in precipitation and increased temperatures. Although this will affect dramatically the livelihoods of people throughout the country, it will in particular be severely felt in urban areas, and more in Kampala, where there are concentrations of economic activity and energy demand.

Another major source of energy vulnerability is that the impacts of climate change disrupt the energy supply chain. The increased intensity and frequency of extreme weather events such as heavy rainfall storms and floods affect energy infrastructure - power plants, transmission lines and power lines - that disrupt energy supply resulting in power cuts and higher energy prices. Moreover, the heavy rains and flooding make road and rail transportation inaccessible. The disruption of rail and road transport indirectly affects energy supply, as fuel is typically brought to the country by train from the coast and distributed by trucks.

Whereas, the demand for energy in Uganda is expected to rise due to population growth, rapid urbanization and economic growth; climate change is likely to further increase energy demand, especially in urban areas. The predicted rise in temperatures and the urban heat island effect are likely to increase demand for electricity for indoor cooling, further increasing energy vulnerabilities.

Another vulnerability is that energy supply in all the urban centres is dominated by traditional biomass (charcoal and firewood for cooking), with electricity and other fuels playing a very small role. The reliance on biomass energy is causing widespread deforestation and land degradation across the country, and above all, in the urban centres studied, charcoal was reported as becoming increasingly scarce and expensive. The current balance between supply and demand for biomass, however, is very fragile and predictions are that there will be a huge deficit of biomass in the 2020s and beyond (Ministry of Water and Environment, 2015a). The CDKN supported study on the economic assessment of the impacts of climate change concludes that a BAU scenario for growth in biomass, demand is not sustainable and a solution is needed to address the predicted deficit.

The first driver of vulnerability of urban energy services is that energy issues are centralized at national level and so urban authorities have no control over the operation of energy services consumed in their areas of jurisdiction. However, any challenges in energy supply affects the activity of the urban authorities as well the daily life of inhabitants and economy. With urban authorities charged with responsibility of physical planning and landscape policy, they should have a significant role to play in energy planning and integration of energy supply in physical energy planning. For example, every new constructed area in a city will generate an additional need for energy and it can be connected to the grid and or resort to renewable energies. With electricity

supply is facing breakdowns and unreliable and it requires serious investments in renewables. To be efficient in the planning and decision-making process, and to achieve energy security over their territories, it is important that urban authorities work hand in hand with national level agencies to integrate energy supply in physical planning and urban development. In other words, to increase energy security and reduce vulnerabilities, urban authority should have some level of control in energy planning and supply.

Some efforts to reduce energy vulnerabilities were reported especially promotion of energy saving cook stoves, LPG, biogas and solar. Though not very widespread, they present a big potential if they are scaled up and appropriately financed. In Fort Portal, the Kabarole Research and Resource Centre is promoting energy saving cook stoves. Life Line is manufacturing and promoting the use of energy saving cook stoves. In Gulu, UNDP and PRELNOR are promoting engagement in sustainable energy technologies (cook stoves) for homes and institutions and are supporting the planting of woodlots for energy/sustainable charcoal production. Charcoal briquettes from solid waste generated in urban areas can be used as alternative sources of energy for cooking and industries while at the same time solving the solid waste management challenge.

With support from the World Bank, Uganda is implementing the Uganda Support for Municipal Infrastructure Development (USMID) programme to enhance the institutional performance and seevice delivery of 14 Municipal Councils to improve urban service delivery: Arua, Entebbe, Fort Portal, Gulu, Hoima, Jinja, Kabale, Lira, Masaka, Mbale, Mbarara, Moroto, Soroti, and Tororo. Under USMID programme municipalities have been supported with s solar street lighting. In Gulu, there is a proposal installing solar in municipal offices and institutions to cater for load shedding and also reduce electricity costs. Under the Second Kampala Institutional and Infrastructure Development Project (KIIDP2), KCCA is also engaged in installation of solar street lighting. Solar is also proposed for Gulu market lighting and powering water supply. Jinja municipality is planning to have the Municipal hall and markets installed with solar to reduce on high costs of electricity. Jinja Municipality is also committed to ensuring that all new buildings have solar installation Amudat Town Council and Moroto Municipality have installed and use solar energy in the offices. Although solar presents, a big potential, its use is generally low both in institutions and households. While the high initial installation cost was noted as a hindrance, in the long run it is far cheaper compared to the high costs of electricity.

4.4.2 Transport and mobility

Transport plays a major role in all economic activities and facilitates growth and development in all other sectors of Uganda's economy, including urban economies. SDG Goal 9 obligates member states to *build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation*". SDG9 Target 1 requires member states to "*develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all"*.

Urban centres have high population densities and mixed landuse: industrial, residential and commercial buildings connected through transport networks/systems. Uganda's urban areas, however, have grown with inadequate physical planning and development control and an urban transport challenge is emerging. Uganda's transport system is dominated by road transport. In the urban areas, most of the roads are unpaved. For example, as of 2013 the length of paved urban roads was 2,122km, only about 20% of the total urban road network (Government of Uganda, 2015a). In many urban centres, the few paved roads have potholes and required rehabilitation

and maintenance.

The transport sector is both a driver and victim of climate change. Transport is a driver of climate change through vehicular GHG emissions. The transport sector accounts for 75.5% of Uganda's national petroleum consumption that represents 67% of the direct GHG emissions from the energy sector (KCCA, 20165b). Overall, the transport sector is responsible for 3% of Uganda's GHG emissions (Government of Uganda, 2015b). A main vulnerability of the transport sector is that it is most exposed sector to increase in fuel prices. Currently, all oil (100%) used in Uganda is imported. Whereas, Ugandan motorists have of recent observed a slight reduction in fuel prices due to the decrease in international oil prices, it is not sustainable to think that an economy can just wait for international fluctuation to make motorist happy with the fuel price. Thus, Uganda is still vulnerable with international events (oil and gas markets, war conflicts…) that affect oil prices. Moreover, although the country is about to start exploiting its oil resources, it is a challenging option because of the impacts of oil extraction on biodiversity and ecosystems, on green tourism and on the increase in GHG emissions. Thus, with the exploitation of oil resources the vulnerability will still remain.

The long-term objective in of Uganda (and especially in Kampala and other large towns) is to reduce the use of individual motorized transport to favour non-motorized mobility, green and public transport; and at the same time reducing the impacts of the transport sector on air quality and traffic. While, improving vehicle fuel efficiency greatly contributes to the achievement of Uganda's transport objectives, a baseline survey showed that the average vehicle fuel efficiency in Uganda was getting worse with time, mainly from the fact that the country was importing older vehicle over time. For example, the average age of diesel vehicles imported into Uganda in 2005 was 10 years and in 2014 it was 18 years. This meant that Uganda was not taking advantage of on-going global improvements in vehicle fuel efficiency[3]. Although there are high potentials for promoting green transport/ eco-mobility especially in Kampala (public transport, bike, car sharing, urban logistic…) but the current stock of jobs (regular or informal) provided by the existing transport is an important factor to consider (boda-bodas, matatu, repairing, recycling…). To succeed in changing the operating mobility in the city, wide consultations with actors will be needed. Actions on both the supply and demand sides have to be managed simultaneously.

On the other hand, Uganda's transportation systems are victims of climate change because a climate change impacts like floods, storms, heat waves and landslides could have severe consequences on the resiliency and performance of surface transport systems and this affects other sectors of the economy. The first vulnerability of urban mobility is the almost exclusive reliance on motor vehicles. The over centralization of economic activities in Kampala city means that many transport streams radiate from the city /Greater Kampala to the whole country. Currently, the main transport challenges in Kampala city (and other large towns) are accessibility and connectivity. There are a few roads and routes as well as limited options for transportation. The limited roads lead to a problem of poor connectivity between neighbourhoods and across the city. The challenge of connectivity in Kampala is manifested in time of increased travel time from different parts of the city to others, as well as costs of travel and cost of maintenance (KCCA, 2015b). A study by Ministry of Works and Transport within Kampala finds that Ggaba route had the highest travel time of 3.1 minutes/km while Entebbe had the least of 1.7 minutes/km (Ministry of Works and Transport, 2012). Moreover, with the absence of a public transport system, increase in motor vehicles and increase in travel time, it means more emission of GHGs. In the emerging cities – Arua, Gulu, Jinja, Mbale, and Mbarara, connectivity challenges are already becoming increasingly

3 Partnership for Clean Fuels and Vehicles, Kampala 14 May 2015 workshop.

visible with the increased population, economic activity and increased vehicles.

Uganda's urban transport is considerably exposed and affected by the impacts of climate change, more especially extreme rainfall events, flooding and landslides. The poor design and poor maintenance urban infrastructure and more especially the drainage systems, heighten the vulnerability. The frequent and high intensity tropical rainstorms generate extremely high run-off that quickly exceeds the capacity of the urban storm water drainage system. Moreover, the infrastructure is typically poorly designed – the drains are relatively narrow and shallow. The urban drainage infrastructure is also poorly maintained. The absence of regular desilting makes the drainage system inefficient with accumulation of sediment and rubbish. More often the drainage channels are full of solid waste critically contributing to flooding.

The roads and bridges are strongly affected by floods. Where the roads are not paved they are impassable when it rains. Equally, the railway line and the navigation infrastructure are strongly impacted by flooding. In particular, flooding affects the safety, efficiency, cost effectiveness and punctuality of transport. Extreme rainfall events and floods often lead to short term breakdowns and sometimes cause permanent damage on road infrastructure. During intense rainfall and storms, roads are often blocked by fallen trees. In addition, storms and floods damage supplementary infrastructure, such as street lighting, flyovers and traffic signs. The railway lines and Lake Victoria's navigation infrastructure are also vulnerable (KCCA, 2015b). Lake Victoria is particularly vulnerable to variations in water levels, due to the shallowness (less than 90 metres at its deepest) and low topographical gradients of the lake. In the hilly and mountainous areas (Mt Elgon, Ruwenzori and Kigezi highland regions), landslide block roads and disrupt transport.

The disruption of transport has critical economic and social impacts. Whenever traffic is disrupted, people and goods are not able to easily move in the urban centres. Given the economic centrality of Kampala, the impacts of floods on the city's transport have far reaching economic and social consequences at country level.

An assessment of the economic impacts of climate change on Uganda's infrastructure (Twinomuhangi and Monkhouse, 2015) found out that the country's major costs on infrastructure (transport and buildings) arise from loss of resilience. The estimated costs could reach US$60–76 million in 2025, rising to US$347–621 million in 2050. Doubling in the frequency of extreme events every 25 years under climate change would result in damages of between US$68–429 million by 2025 and up to US$938–3,236 million by 2050. This is equivalent to 0.1–0.4% of GDP in 2050. In Kampala (the capital city), the cost of inaction estimated for flooding alone suggests annual damages rising from US$1–7 million in 2013 to US$33–102 million by 2050. An extreme event similar to the El Niño floods in 2007 would cost significantly more. This means that adaptation measures are necessary to mitigate these costs

Under the USMID programme, 14 municipalities are being assisted with infrastructure development more especially rehabilitation of selected roads in the municipalities. The roads have been paved and drainage channels constructed to control flooding. Solar street lighting and waste collection bins have also been installed on the rehabilitated roads. So far 73 roads covering about 40km have been completed (MoLHUD, 2017). In addition, the 14 municipalities have been supported to develop Drainage Master Plans, and once these are implemented, they will reduce the vulnerability of the towns to flooding. In order to control flooding in Kampala, a City Master Drainage Plan was developed and is implemented under KIIDP2.

4.4.3 Housing and the built-up environment

Housing is a basic human need and is one of the indicators of a person's standard of living. Housing conditions have an impact on people's health, welfare, social attitudes and economic productivity. Housing accounts for about 70% of landuse in cities, and determines urban form and densities as well as the ability of cities to provide employment and contribute to economic growth (UN Habitat, 2016b). In Uganda, housing has not been central to government programmes such as the Poverty Eradication Action Plan (PEAP) and the provision of adequate and affordable housing is far from being achieved (Ministry of Local Government, 2010). In most cases, housing provision has been left to the private sector which has focused more on the needs of the high and middle-income earners, leaving the low-income earners and the poor to be catered for by the informal sector, a situation that has partly contributed to the spontaneous growth of informal settlements.

With this challenge, coupled with inadequate physical planning, urban growth and expansion in Kampala and the other large towns is characterized by high-density housing that is not evenly distributed. Lower and middle-income neighbourhoods have high densities compared to high-income neighbourhoods. The poor live in the high-density neighbourhoods that are largely informal and most of them are slums. The slums are mainly in high flood risk locations and lack the requisite infrastructure and services (transport, water and sanitation, drainage, waste management etc) to withstand the effects of climate change (KCCA, 2015b).

Climate change heightens vulnerability of urban poor and other marginalized groups that reside in slums/informal settlements to flooding and other disaster risks. In Kampala, the vulnerability is heightened by the fact that most of the buildings in slums are in or around wetlands, and they are poorly constructed. When floods occur some of the buildings collapse or become uninhabitable. A study on the economic assessment of the impacts of climate change on infrastructure found that residential buildings are highly exposed to climate risk followed by public buildings and non-residential buildings. The costs arising from loss of resilience in residential buildings to the effects of climate change in Uganda is estimated to reach USD 60-76 million in 2025, rising to USD 347-621 million in 2050. In Kampala city, the home to the majority of the country's built infrastructure, projections of future climate in the city suggest that there will be a higher incidence of rainfall, putting Kampala at risk of severe flooding. The cost of inaction for the city is very high, with annual estimates for the cost of damages from flooding rising from USD 1-7 million in 2013 to USD 33-102 million by 2050 (Ministry of Water and Environment; 2015; Twinomuhangi and Monkhouse, 2015).

Another major source of vulnerability is lack of climate proofed buildings/facilities construction and renovation standards at the national and local levels to address climate change and energy issues. In addition, with the general lack of awareness and knowledge on climate change many urban building projects are designed and implemented without incorporating bio-climatic principles. Bio-climatic principles help guide consideration of the environment and natural components around the future buildings instead of considering only the building. For example, at the plot level it is possible to recover rainwater, to produce energy, to treat some wastes or wastewater, to reduce run-off, to use nature (vegetation) as a component of the thermal regulation of the building and as a noise prevention component. It is also possible to facilitate eco-mobility, and to use eco-materials in construction.

Moreover, modern buildings being constructed in urban areas, for tertiary activities (health, education) but also for tourism (like hotels), are not taking into consideration of the current and future climate conditions. There is a lot to do at local level through landscaping policies, to the

plot level (standards, eco-neighbourhood) to reduce the urban sprawl and to improve the design and construction of resilient buildings. This can be achieved through a strong cooperation between national and urban authorities.

4.4.4 Water supply

Water is an important resource and a basic human need and right, without which human beings cannot survive. Water is essential for fighting hunger and poverty and is fundamentally essential for effective primary health care and hygiene. It is also an important resource for electricity generation, fishing, tourism, transport and industry. In urban areas, therefore, water availability is a key to the growth of urban economies, fighting urban poverty, and maintaining healthy urban systems. Generally, Uganda is well endowed with fresh water resources i.e. various fresh water lakes and rivers. However, the country's water resource base is closely tied to prevailing climate because lakes are mainly fed by rivers, and rivers flow either from glaciers and ground water resources. The changing climate is already causing stress on water resources, and the projected future climate will amplify stress on water availability and this will significantly affect the population, economy and the environment.

Access to clean and safe water is one of the SDGs (SDG 6) and Uganda's NDP II focuses on achieving 79% and 100% access to safe water in rural and urban areas respectively (UBOS, 2017). The main sources of water for urban areas are piped water (51.9%), boreholes (18%), protected spring/ well (13.5%), gravity flow scheme (0.7%), while 16% draw water from unprotected sources like rivers, streams, ponds, and lakes that are more likely to carry disease causing agents (Government of Uganda, 2016a). The 2016/2017 National Household Survey (UBOS, 2017) indicated that 7.7% of urban population draws water from unimproved water sources.

The vulnerability of water resources and water supply in Uganda's urban areas to the impacts of climate change is mainly related to droughts, floods, and storm water. The availability of water resources is affected by droughts and heat waves, and the quality of water depends on how the reservoirs can be affected by floods, storms and even droughts.

In recent years, drops in Lake Victoria water levels (Awange et al., 2008) and accelerated melting of the Rwenzori ice caps have been attributed, in part, to climate change. These have led to a reduction in natural water stores and exacerbated downstream seasonal variability (World Bank Group, 2015). The findings of an assessment of the vulnerability of Uganda's water resources to climate change indicate that the predicted increase in temperatures combined with a reduction in rainfall in the Lake Victoria region is likely to result in higher evaporation and declining water levels in Lake Victoria (Ministry of Water and Environment 2009; Baastel, 2015b). Uganda's rapidly growing population and rapid urbanization will increase the demand for water but the predicted impacts of climate change (especially droughts) will reduce water availability. It is estimated that between 2010 and 2050, the demand for water in Uganda will increase almost ten-fold, which demand cannot be met under the current investment plans. The unmet demand is calculated by the study to be USD 5.5billion per year (Twinomuhangi and Monkhouse, 2015).

In Kampala, the city's water supply is likely to be affected by climate change because most of Kampala's fresh water supply is drawn directly from Lake Victoria. For example, when Lake Victoria water level dropped (2004-2006), the water pipes could not pump water and water supply was restricted. NWSC had to extend the pipelines deeper (210 meters) into the Lake spending € 6.5 million (KCCA, 2015b). The cost of water treatment has also increased water prices and this itself is a health risk, as many urban poor cannot afford the water prices. With the projected climate change and its impacts, the treatment plant and general water supply are at risk due to the falling

lake levels. Many other urban centres are already facing water stress. For example, the water sources for Amudat, Arua, Gulu, Kiruhura, Mbarara, Moroto, and Nakasogola dry up during the dry seasons leaving the urban residents water stressed. Prolonged dry seasons and droughts in the recent years have resulted in reduced water levels in the Oyitino stream/wetland that is a source of water supply for Gulu Municipality, River Rwizi that is a source of water supply for Mbarara Municipality and River Enyau for Arua Municipality. Similarly, some boreholes, valley dams and protected springs that are sources of water for Paidha, Amudat, Kasese and Kiruhura have dried up due to long droughts resulting in severe water shortages.

Another source of vulnerability is water quality. Water sources are exposed to contamination or pollution from various sources. Land degradation arising from increased deforestation; encroachment of wetlands and cultivation on steep slopes and riverbanks increases soil erosion and run-off, which result into siltation and contamination of water sources. Poor solid waste management practices, poor sanitation and discharge of industrial pollutants in water also compromises water quality, and a case in point is Lake Victoria. Poor sanitation practices witnessed by sewerage overflow combine with runoff and use of pit latrines in areas with high water tables like in Malaba is another danger in polluting the water sources. Equally, the effects of floods on water quality are appalling in all the urban areas in which the study was conducted. With the predicted climate (increased intensity of rainfall) the impacts of flooding on water in the future will be severe, but more importantly they are likely to be more indirect, through increased cost to treat water, than direct, through the damage of the infrastructure (Ministry of Water and Environment, 2015a). In the past two decades, the potential of the wetlands to remove nutrients and pollutants has been greatly reduced due to continued pressure by extension of farming, human settlements and industrial establishments into wetlands Currently, Mbarara Municipality is facing severe water stress because of reduced water in River Rwizi (the major source of water supply) partly resulting from land degradation in its catchment. In places like Kasese, Malaba and Moroto, silting equally threatens the water sources. Extreme weather conditions (long spells of drought and flooding) have and continue to compromise water sources in some of the study areas.

Another vulnerability of water security to climate change is that water supply (pumping and distribution) needs energy and the vulnerability of the energy can also increase vulnerability of water supply. Many urban areas were reporting water shortage because of unreliable electricity to pump water. With energy supply itself exposed to the impacts of climate change, its vulnerability will translate into more water shortage in the urban areas.

The mandate for urban water production and water supply is managed at national level, by the National Water and Sewerage Corporation (NWSC), and not by the urban authorities. This in itself is a driver of vulnerability. In all the urban centres visited during the study, NWSC is not unable to cover the entire towns with piped water and alternative sources of water have to be sought, including boreholes, protected and unprotected springs, streams, rivers, swamps and wetlands. In addition, the water connection costs and tariffs are so high and the poor communities indicate that they cannot afford them. In some cases e.g. in some parts Amudat, Kiruhura and Nakasongolatown councils, people are sharing water with livestock more especially during dry seasons (rivers, valley tanks/dams etc.). In all these, urban authorities are constrained because they have no control over water supply or regulation. However, urban authorities are responsible for the delivery of services that are closely related with water supply: public health, environment protection, urban planning, private water sanitation (public building, schools) and roads (under which networks are installed). The challenge is that these services cannot be effectively delivered without controlling water supply. Another challenge is that urban authorities are responsible for spatial planning and

they should have a streamlined way in which urban utilizes and services (water, electricity, and communication networks) are laid so that they do not spoil the existing infrastructure e.g. roads. Furthermore, the development of these different networks (including water) strongly relates to the welfare and standard of living of the urban population, which urban authorities are also responsible for. It is essential therefore those urban authorities be involved in water supply in their areas of jurisdiction.

As part of adaptation in water, the protection and the monitoring of water bodies and of the sources are very important. Protection of water catchment areas and ecosystems is essential for ensuring water availability and water quality. Water resources must be protected from potential negative externalities resulting from urban sprawl and high population growth. Reducing water leakages (in piped water supply) and developing rainwater-harvesting systems can contribute to increased water availability as well as the resilience of water resources. For example, in order to cope with droughts and ensure that there is a sufficient and timely supply of clean water in the Kampala area, there is need to drastically reduce the physical losses of water, manage carefully the impact of hydroelectric generation in water levels at Lake Victoria and abstract water not only from Murchison Bay, but also from Katosi Bay.

In most urban areas studies, rainwater harvesting is recognised as a potential for addressing water security and reducing floods, its use is still very minimal - limited to few households, institutions and business entities

4.4.5 Sanitation

Sanitation is a critical component of human life, and SDG6 goes beyond addressing clean and safe water to also address sanitation and hygiene. Access to good sanitation ensures dignity and helps prevent the spread of waterborne diseases such as cholera that are associated with faecal contamination. Uganda's NDP II, targets to improve sanitation and hygiene levels in both rural and urban areas. The 2016/17 UNHS (UBOS, 2017) finds that 83% of households in Uganda use pit latrines, only 3% of households use flush toilets and 7% use bushes/do not use any toilet facilities. In urban areas, the proportion of households that used pit latrines was high (73.9%), as compared to VIP latrines (16.5%), flush toilets (7.6%) and 2% do not use any toilet facilities. These sanitation conditions increase the level of water contamination and heighten the vulnerability of urban areas to the impacts of climate change and most especially floods

NWSC is the principal provider of sewerage services in the large urban centres of Uganda. Currently the coverage of the main sewer network is only 8% in the towns that are served by the NWSC (Ministry of Local Government, 2010). In most of the towns served, it is only the Central Business District (CBD) that access the sewerage services, and this implies that most of the areas and population are not accessible to the main sewer. The lack of comprehensive sewerage network, adequate wastewater treatment and the subsequent discharge of wastewater into the wetlands and lakes are key drivers of degradation and loss of ecosystem services in most parts of the country.

In Kampala city, only 10% of the population primarily in the CBD and affluent areas is served by the sewer system, 20% use septic tanks and the remaining 70% rely on on-site sanitation (World Bank, 2015b). In the other large towns (Arua, Gulu, Jinja, Kabale, Mbale and Mbarara), the central sewer system is dilapidated and overwhelmed, and overflows are common due to blockage and broken pipelines, dysfunctional manholes and flooding. Breakdown of sewer lines is a health hazard, because when it rains, the wastewater mixes with storm water in drainage channels. The use of flying toilets (*'kavera'*[4]*) especially in Jinja, Malaba and Mbale* and release

4 Kavera is a polythene bag

of faecal matter from septic and pit latrines when it rains increases the likelihood of pollution and outbreak of waterborne diseases like diarrhoea, cholera and typhoid. In Mukono Municipality, some households release faecal matter from septic tanks and pit latrines into the wastewater when it rains. Environmental health problems related to poor sanitation were reported in Mpondwe-Lhubiriha, Malaba, Kasese and Amudat where outbreaks of cholera and typhoid cases are frequently registered. In Moroto, hepatitis E, diarrhoea, occasional dysentery and also cholera do occur. In Amudat, where pit latrines are the common sanitation facilities used, the coverage is very low and open defecation is a common practice.

However, there are also some good practices. NWSC is currently expanding the sewer network in Kampala with a target to double sewerage coverage and access. The UGS 420 billion sewerage plant being built at Bugolobi will also generate 620kw of electricity from biogas (Bwamable and Waiswa, 2017). In Fort Portal, the sludge cake from the sewerage lagoon is used for manure. In Paidah, NWSC has constructed communal eco-san toilets in Akir, Aringo, Arutha villages and Jupanyondo west. The same has been done in some schools like Oturgang and Nguthe Primary Schools. The use of eco-san toilets could be explored in the urban areas in an event that water supply and waterborne sanitation system is far from being achieved.

The effects of climate change are already accentuating the problem of sanitation in urban areas. For example in Kampala city, most of the urban poor settlements are in flood prone areas, which have high water tables. During heavy rainfall and floods, the resultant overflow of human waste increases the population's vulnerability to poor health and water borne diseases like cholera, typhoid and dysentery. These disease epidemics are reported to be increasing during periods of heavy rains. In the case of water stress, less water implies increased health risks of diseases related to dry conditions.

KCCA, through the Kampala Physical Development Plan (KPDP) 2012, plans to upgrade the water and sanitation systems. This will involve upgrading the water network supplying high-density residential areas (including slums) to ensure increased access to affordable clean and safe water. An additional 400,000 people will be connected through network densification, construction of around 3,000 public water points and yard taps with electronic pre-paid meters. This programme is vulnerable to the projected impacts of climate change especially droughts and falling water levels. The assessment of the past and present impacts of flooding indicate that the future impacts of flooding are likely to be more indirect, through increased water treatment costs and the damage of water supply infrastructure.

4.4.6 Solid waste management

SDG 12 Target 5 urges member to promote sustainable consumption and production patterns, and target 5 is specific on waste management urging member states to substantially reduce water generation through prevention, reduction, recycling and reuse. In Uganda, solid waste management is one of the decentralised services, delivered by local governments. Urban authorities are responsible for the waste collection, transportation, treatments and disposal in their areas of jurisdiction.

As already mention in section 2.6.10, solid waste management is one serious challenge for sustainable urban development in Uganda. The rapid population growth and urbanisation is translating into increase waste generation in all urban areas, and the urban areas lack the capacity to effectively manage the waste. Most of the urban solid waste is organic (83.6%) and waste paper (10.9%), mainly originate from household, business premises and offices. Other materials include: wastes plastics (1.2%), waste metals (0.3%) and glass / cullet materials (0.1%) while

other miscellaneous materials such as broken pots, enamels, containers other than plastics and metals constitute 3.9% (Government of Uganda, 2015b).

The main solid waste management practice is collection and disposal. Waste collection is a very expensive service requiring large fleets of vehicles. The main concern is the fuel supply, rise in fuel prices and energy efficiency of vehicles. All the urban areas have few waste collection vehicles and the few ones available are not well maintained. The waste collection budgets are also small and as a result more waste is generated than is collected. In Kampala city, for example only 40-50% of the waste generated in the city is collected and disposed at the Kitezi landfill. In the slums and informal settlements where accessibility is a big problem, waste collection vehicles cannot reach the households and so a lot of waste remains uncollected. Open burning of waste, open dumping, and illegal dumping on roadsides and drainage channels are practiced. These disposal practices are associated with public health problems, blockage of drainage systems, air pollution, odours, and general degradation of the urban environment. During the field visits to the selected urban centres, heaps of uncollected wastes were a common site on roadsides and drainage challenges. In Kampala, private waste collectors are involved in waste collection at a fee, but the urban poor who reside in these neighbourhoods cannot afford to pay for the waste collection services.

Solid waste management is a climate change concern. The waste sector is one of the major emitters of GHG emissions (methane) and is thus a driver of climate change. For example, the emissions from the waste sector in Uganda increased by 71.9% between 1994 and to 2005, and by 38.0% between 2000 and 2005. The GHG emissions are mainly because most of the waste is organic in nature, which is a source of methane and hence GHG emissions. Moreover, the main disposal method is by open dumping and landfill, without methane valorization. However, the capture of the methane from the landfill could be a huge source of revenue and jobs and a way to significantly reduce the contribution of the waste sector to turban GHG emissions. Therefore, mitigating GHG emissions and energy recovery should be prioritized in urban waste management.

Another vulnerability associated with solid waste management is flooding. The waste dumped on roadsides and in drainage channels is not only a driver to flooding during rains, but it also contaminates water. The vulnerability is also related to transport because road infrastructures are flooded during rains and waste collection cannot be done. Landfills can also be flooded and are also exposed to potential fires and to methane emissions. Open waste can create serious challenges when violent storms strike with potential obstructions to the flow of rainwater or contaminating water and reducing air quality. High temperatures and droughts increase the decomposition waste leading to bad odour and increased dust in the neighbourhood.

Under the USMID programme, 14 Municipalities have been supported to prepare solid waste management strategies, although the strategies are yet to be implemented. In addition, municipalities involved in this study (Arua, Fort Portal, Jinja, Kabale, Kasese, Lira, Mbale, and Mbarara) put in place waste compositing facilities under the Clean Development Mechanism (CDM) waste compositing project led by NEMA. Waste is collected and sorted at the composting facility and then compost produced from organic waste, while the plastic materials are recovered for recycling. The stakeholders consulted in the municipalities where the composting project was implemented reported the waste management challenge had greatly reduced. However, the municipalities still have a challenge of transporting the waste to the composting plant (mainly the cost of fuel and maintenance of waste collection vehicles), which they find costly. In addition, the municipalities are stuck with the compost produced by the plants because the market for the compost is not sustainable. Moreover, the non-biodegradable waste (plastics, e-waste, debris and polythene have accumulated at the composting sites and are posing a pollution challenge. It is essential, thus, for

urban authorities to encourage recycling of non-biodegradable waste as way of improving waste reduction and public health, while at the same time creating jobs and reducing poverty.

For adaptation in waste management, there is a strong need for sensitizing and educating the technical staff, political leaders and the wider public on the value of sustainable waste management practices, so that there is change in attitudes and behaviours. Waste should not be looked only at as a problem but as a potential or a resource. Waste prevention and education campaigns can foster new business development in the recycling industry. There is also a huge potential for waste to energy initiatives. There are potentials of converting methane to biogas production or for electricity generation and also from waste incineration, which are not yet exploited.

A significant improvement in the management of the whole waste management value chain can create positive impacts in terms of green development and job creation through waste prevention and reduction, recovery, reuse and recycling. The success of green jobs development in waste management is dependent on collaborations and partnerships between the central and local governments, and the private sector. Until now, there is no sound industrial ecology or circular economy approach in the waste management sector.

4.5 Urban economy vulnerabilities

The vulnerability of an economy to the impacts of climate change depends on the structure of the economy itself. In Uganda, many sectors of the economy are exposed to climate change impacts especially agriculture, forestry, tourism, fisheries, industry and trade. Urban economic activities are also vulnerable to climate change and yet they contribute significantly to Uganda's GDP. For example, we already mentioned that Kampala (and Greater Kampala), which is highly vulnerable, contributes almost 60% of the national GDP.

Although many of Uganda's urban areas have a favourable climate and natural environment that can support a variety of economic activities, this environment is very fragile and sensitive to climate change and (human) planning decisions. Heat waves, drought and floods can all affect the local economy of the urban areas and the surrounding regions. Declining of urban agriculture and forestry yields, loss of biodiversity and ecosystems, deterioration of working conditions in offices, deterioration of health conditions of the most vulnerable people, damages to infrastructure preventing movement of people and goods, loss of attractiveness of tourism destinations, deterioration of water quality, unavailability of appropriate trade areas, loss of time-money due to traffic jams, disruptions in energy supply etc. When the urban economies are affected by the impacts of climate change, the hinterlands' and national economies are also affected. When we consider Kampala's economy and its influence on the country and the neighbouring countries (South Sudan, Rwanda, Burundi and Eastern DRC), the outside economies are also affected by the impacts of climate change on Kampala.

Integrating climate resilient and sustainable environment management in urban development is thus crucial for making the urban economy more viable and for promoting local economic development. The increased resilience of urban economies helps to enhance the attractiveness of cities and to foster innovations.

4.5.1 Urban poverty

SDG1 urges all countries to eradicate poverty in all its forms and is central to the achievement of all the global SDGs and sustainable development agenda. Target 1.5 in particular urges member states to build the resilience of the poor and vulnerable, and reduce their vulnerability to the

impacts of climate change and other environmental shocks and disasters. Recognizing that poverty eradication and vulnerability to climate change are main constraints to Uganda's growth and development, the NDP II aligns Uganda's development agenda to the global SDGs.

The most commonly used metrics to assess socio-economic vulnerability is household income. This is because poor individuals and families have less flexibility in their financial resources, meaning they are less resilient because climate change impacts undermine their earning capacity and this has consequences on access to food, housing, services and health. Those living in slums and informal settlements often have no choice but to settle in areas that are particularly exposed to hazards, and also lack hazard-reducing infrastructure such as drainage and sanitation. In most cases they also lack well-constructed housing with security of tenure to ensure that they can return to their homes after disaster events.

In addition, poor households lack savings or large food stocks that they can draw on overtime in case disasters occur. They are thus not able to allocate resources to things like disaster recovery or preventative maintenance. Without financial resources or strong social networks (safety nets) that can assist during times of trouble, lower income families are less likely to rapidly and effectively rebound from extreme weather events. Other stressors such as the loss of a job or family illness can easily compound the vulnerability of the urban poor. The 2016/17 Uganda National Household Survey (UNHS) finds that 27% of Uganda's population are poor, corresponding to nearly 10 million persons. Though the incidence of poverty is higher in rural areas at 31%, still a sizable proportion of the urban population (15.2%) lives in poverty. Indeed, urban poverty is on the rise, having increased from 9.6% in 2013 to 15.2% in 2017 (UBOS, 2017). The high urban poverty means that the urban areas many economically vulnerable individuals and families.

4.5.2 Agriculture

In the urban economy, agriculture is not as important as it is in the rest of the country but indirectly; urban areas are exposed to agriculture through food supply and food security. Cities heavily depend on hinterlands for their food supply and in many cases the food is transported very long distances to the city. This dependence on food from outside not only increases the cities' carbon footprints but also makes cities highly vulnerable to food insecurity.

There is no concrete data on size of land under urban agriculture in Uganda. However, in Kampala city it is estimated that about 40% of the undeveloped land in the city is utilized for crop production. However, most of these agricultural activities are poorly organized resulting into low productivity and low incomes. The most recent livestock census indicates that about 22% of the households in Kampala rear at least one type of livestock or poultry and 47 farmers are practicing aquaculture" (KCCA 2014). In many other urban centres in Uganda, urban agriculture is an important economic activity. Agriculture is then a very important cross-cutting issue in urban areas regarding to health, environment and physical planning, and more especially with increased urbanization and urban sprawl. In Kampala, food is produced from very small-scale farming but demand is growing high and stock will reduce in the future.

Urban agriculture is also vulnerable to changes in rainfall associated with climate change that will lead to an overall decline in production. The impacts of floods are already affecting urban farming since some of it is carried out in drained wetlands. In terms of food security, it is important to note as well that floods are likely to affect it also indirectly, through the disruption of transport of goods cultivated or produced elsewhere.

Developing urban agriculture is strategic to creating local employment, increasing food security, reducing urban sprawl, improving infiltration of rainwater on land, and also reducing the GHG emissions associated with transportation of food and raw material supplies from outside the urban areas. Urban agriculture can also be source of household energy – biogas. Currently KCCA and GoU are leading a study on the valuation of biogas from farming. However, it is important to recognize that urban agriculture competes for land with other land uses. With future urban growth, the potential agricultural area will reduce because the land rent from urban farming is lower than the rent from other uses such as residential, industrial and recreational. Thus, urban farming is vulnerable, threatened by displacement to the periphery, which will increase costs and even make it impossible to sell some perishable crops in cities (Vermeiren *et al.,* 2013).

Through physical planning and economic development, urban authorities can mobilize different actors to promote urban agriculture. Since climate change makes the weather less and less predictable, climate information systems to inform and sensitize farmers are necessary to promote urban agriculture. For example, in Kampala city a portion of land at the agricultural resource centre at Kyanja has been allocated to physical planning to setup a nursery for raising tree seedling to be planted in the city.

4.5.3 Tourism

Tourism industry is one Uganda's largest and fastest growing sectors. With a rich biodiversity and beautiful landscapes, Uganda is considered to be one of the premier tourism destinations in Africa. The tourism industry accounts for 9% Uganda's GDP (amounting to USD 1.7 billion) and it earns the country about USD 1 billion annually (Government of Uganda, 2015a). The sector is one of the five prioritised areas considered to have a multiplier effect on the economy.

Given that Uganda's tourism is nature based is vulnerable to the impacts of climate change. Tourism is related to climate, as tourists prefer spending time outdoors and travel to enjoy the various touristic destinations (both natural and cultural). Weather and climatic conditions are some of the factors/criteria that tourists take into account when choosing a destination. Thus, the effects of climate change (the rising temperature and changes in rainfall patterns) affect tourist activities.

Urban tourism is an important potential for Uganda that could enhance urban economies, providing employment opportunities and serving as an important market for Uganda's products. There are several spots with tourism potential in urban centres in Uganda. For example, some urban areas have historical monuments as well as religious, cultural and recreational sites that could be of tourist interest. For instance, towns like Mbarara, Hoima, Kampala, Jinja and Fort portal have the potential to become key tourist destinations in Uganda. In Fort Portal, Hoima and Mbarara Municipalities, the Tooro, Bunyoro and Ankole Kingdoms could be used to promote cultural tourism.

Kampala city as well Entebbe, Jinja, Fort Portal, Kabale, Kasese and Mbale could become important tourism destinations if the tourism potentials are well developed. For Kampala and Jinja, tourism potentials include Lake Victoria and the Nile River, fresh water sports and leisure activities. In Kampala, cultural and religious tourism, is significant but has not been exploited, marketed and its supporting infrastructure is still very limited. The vast bulk of Ugandans are not aware of these facilities, while at the same time the tourists and visitors to Uganda just travel through Kampala, generally staying in the city for a given period of time and not taking time off to visit these interesting sites. Apart from the business sector in most cases the tourists are not attracted to Kampala (National Museum, Lakefront, historical, religious and cultural sites, Festival…) itself but rather to the country's natural assets elsewhere (KCCA, 2014).

The direct and indirect impacts of climate change on tourism are mainly on facilities (especially accommodations and leisure facilities) and the transportation of tourists. Some tourism sites are exposed to floods. Transport is one of the factors that hinder urban tourism. In Kampala for example, the use of personal vehicles and high traffic congestion negatively affect tourism as they raise transport costs, increase travel time and reduce air quality. The image of a "green" city is not yet realized (KCCA, 2015b). With the predicted climate change, there is high likelihood of air quality degradation, heat waves and floods that could be a barrier to visiting tourists or make them reluctant to visit many urban centres.

World over eco-activities and green tourism are very attractive nowadays. However, Uganda's urban settings (particularly in Kampala), have not yet taken this direction. The growing demand for green tourism can be indirectly beneficial to the green economy and reduce vulnerabilities. In partnership with the Uganda Tourism Board and tourism associations, green tourism can be developed with a diverse range of actions: helping touristic industry actors to develop eco-tourism activities, environmentally sustainable tourism destination and activities, energy efficiency in tourism facilities, renewable energy environmentally friendly product and service, among others.

A number of Municipalities have made tourism a development priority in their strategies and plans. Given the likely impacts of climate change on tourism products and destinations, it is important that they develop their tourism is a climate resilient manner. In line with the Vision 2040, Fort Portal is moving towards becoming a strategic tourism city. For example, tourism is mentioned in the vision statements of the Municipal Development Strategies (MDS) of Fort Portal and Kabale Municipalities. The vision of the Fort Portal MDS is *'a sustainable and prosperous city with excellence in tourism, commerce and industry by 2040'* while that of the Kabale MDS is *'to become a beautiful tourism city with prosperous people by 2040'*. In the Mbale MDS, tourism is mentioned in the mission statement, while in the Entebbe and Masaka MDS, tourism promotion and development is among the development priorities of the Municipalities. In addition, the Kasese Five Year Development Plan 2015/16-2019/20, tourism is one of the key sectors for local economic development.

4.5.4 Trade and Industry

Uganda's industrial sector is the second largest sector after agriculture. However, agriculture plays a significant role in industry because it produces raw material for agro-based industries (meat, fish, milk, coffee, grain milling, tea etc.). Textiles, sawmilling, and chemical products are also part of the industrial sector. Therefore, the climate change vulnerability of agriculture also extends to industry. We also need to recognize that about 80% of the country's industries are located in Kampala, and thus the vulnerability of Kampala to the impacts of climate change also extends to industry. In most of the urban areas, trade is an important activity.

Industrial activity is vulnerable to impacts of climate change. The raw materials used by the industry come from sectors that are highly exposed to climate change especially agriculture and fishing. The security of supply of the raw materials is affected by extreme weather events - droughts and flood impacts on crop production, livestock production and on fisheries. In addition, floods and heavy storms affect transport infrastructure (road, rail and bridges) and this affects the movement of raw materials from sources and manufactured products to the market.

Industrial activities consume a lot of energy. In Uganda, industry consumes 15% of the petroleum products, large-scale industry consumes 47% of electricity, and small-scale industrial users consume 11% of electricity (Government of Uganda, 2015a). Therefore, the high vulnerability of energy (supply chain and price) to the impacts of climate change also exposes manufacturing

industries to those impacts. About 5% of the industry sector relies on biomass energy, which is a driver to deforestation and GHG emission through combustion.

The establishment of industrial sites is also a major issue in terms of impacts on the environment, exposure to climate risks (floods, fires, droughts) and impacts on road traffic. Industry has historically been located in wetlands (Kampala and Jinja). Between 1920 when spatial planning was first implemented in Kampala and 1994, industrial location policy involved gazetting of wetlands for industrial activity. This explains the existence of many industries in wetlands within the city - Kyambongo, Ntinda, Industrial Area and Nalukolongo are all in wetlands, which are affected by flooding (KCCA, 2015b).

The trade sector is highly fragmented and scattered throughout the urban space in all urban areas. However, some commercial centres are located in flood prone areas. For example, in Kampala, emerging commercial areas like Bwaise, Ndeeba, Kalerwe, Nakulabye and Kasubi are located in flood prone areas. It is projected that the total number of people on steep slopes and flood-prone areas in Kampala could double by 2020 and even triple by 2030 if the present trends continue (Vermeiren., 2012).

Through psychical planning and development control, urban authorities control landuse in the areas under jurisdiction, and thus have the opportunity to work on an industrial and shopping activity planning and development to make them more climate resilient. Urban authorities can work on urban agriculture policy that would improve security of supply of raw materials. It would also be important for urban authorities to assess to all industrial potentials in terms of energy recovery (sawmill chips, agricultural waste, waste water, solid waste etc.) and industrial ecology. Energy savings, energy recovery and renewables can save money, improve the value chain and reduce the vulnerability of the industry to climate change risk and disasters.

With Uganda aiming at attaining a green economy, specific programmes between national and local authorities should be developed to support green economic development in urban areas, and especially industry. Supporting the green economy will make cities attractive destination for both tourists and investors. Therefore, national and the local development strategies should seek for climate change solutions that promote green economies and benefit the local economic sector.

4.5.5 Fishing

Fishing is one of Uganda's most important sectors of the economy contributing about 1.6% to GDP (UBOS, 2016). Uganda's fishing activities are mainly dependent on natural water bodies, with lakes accounting for 90% of the total fish catch. The main sources of fish are the five major lakes: Victoria, Albert, Kyoga, Edward and George. However, over the years, there has been a decline in fish production from the lakes due to receding water levels and proliferation of the water hyacinth that affects the breeding of fish as well as the use of illegal fishing gears, capture of immature fish, fishing in breeding areas as well poor management and control (Ministry of Water and Environment, 2009).

There are a number of urban centres along the shore of Lake Victoria (e.g. Kampala, Entebbe, Jinja, Masaka and Mukono) in which the livelihoods of some people depend on fishing. In these urban areas, fishing is potentially an important economic activity that can promote local economic development. However, the Lake Victoria shores are very sensitive ecosystems. The Kampala Strategic Plan 2014-2019 indicates that about 1,200 people directly involved in fishing at the three landing sites at Portbell, Ggaba and Munyonyo. In Jinja, many people are engaged in fishing at the Gomba and Agro Marine Landing sites. For KCCA, fishing as a potential economic sector has

not been fully exploited and the implementation of the Strategic Plan seeks to improve the city's fisheries sector.

Fishing is highly exposed to the impacts of climate change, more especially the rising temperatures and reduced rainfall that affect water levels in water bodies. Lake Victoria's navigation infrastructure is particularly vulnerable to variations in water levels due to its shallowness and low topographical gradients (Ministry of Works and Transport, 2012). Reduced water level on the lake makes fishing activities along the shores very sensitive. For example, in 2006, the shoreline of Lake Victoria retreated by up to 50m affecting shipping and fishing industries, as fishing boats could not easily get to the landing sites (Ministry of Works and Transport, 2012). In such circumstances, fish catches must then be hauled ashore through shallow contaminated edge waters, and this compromises fish hygiene within the supply chain. Bacterial loading of fish carcasses results in high or total catch rejection by European fish importers and results in significant post-harvest losses (Ministry of Water and Environment, 2009).

The exposure of fishing to the impacts of climate change impacts also relates to the quality of water and reduced biodiversity. The indirect climate change impacts on fishing can come from other sectors such as poor sanitation that contaminates water as well as landuse change that includes among other conversions of wetlands to other uses (urbanization, industrial and agriculture). During the past decades, the Lake Victoria ecosystems have significantly changed. There is increased and diversity of activities, dwindling water quality (e.g. oxygen depletion), loss of fauna population and changes in shores arrangements. The reasons are diverse: population increase and urban sprawl, changes in landuse, over fishing, species introductions, and pollution from various urban activities. With these existing challenges, climate change will worsen water quality/availability and the productivity of fishing activities.

The vulnerability of fisheries to future change in climate is related to a combined effect of the predicted warming and variability in rainfall. It is also related to the relative importance of fisheries to national and urban economies and diets, and limited societal capacity to adapt to potential impacts and opportunities (Allison *et al.,* 2009). Although the precise impacts and direction of climate-driven change for particular fish stocks and fisheries are uncertain, the vulnerability of climate change impacts are likely to lead to either increased economic hardship or missed opportunities for development in Uganda whose economy and people's livelihoods depend upon fisheries but lack the capacity to adapt (Twinomuhangi *et al.,* 2012).

Adaptation of the fisheries sector to future impacts of climate change requires climate information/ monitoring of climate change impacts on the lake and its ecosystems (direct impacts on the lake and indirect impacts due to human activities), and the protection of water resources. Uganda has embarked on promoting aquaculture and fish farming. For example, KCCA is experimenting fish farming (cage farming in Ggaba). A fish farming demonstration centre 'China-Uganda Friendship Agricultural Technological Demonstration Centre" has been opened and it trains local farmers in fish raising techniques and includes a fish hatchery and feed factory (KCCA, 2015b).

4.6 Social vulnerabilities

4.6.1 Public Health

Climate change has significant direct and indirect health implications for Uganda's population, both rural and urban. The projected warming will result in heat waves and droughts. The growing variability of inter-annual rainfall is projected to continue including increased rainfall occurrences in some areas, reduction in rainfall in other areas and increased rainfall during the dry seasons.

The projected increase in droughts and floods is likely to exacerbate diseases occurrences and other health-related challenges. In addition, climate change impacts are likely to increase the prevalence of several diseases that are already endemic in Uganda (USAID, 2014).

Malaria is endemic in 95% of Uganda and it poses significant economic and social costs (Ministry of Health, 2005). Increased temperatures will increase the breeding of mosquitoes and parasites. Increased rainfall is likely to provide favourable breeding sites for mosquitoes and result in a higher burden of malaria. In Kampala, an upsurge of malaria cases was reported in 1997 after the El Niño heavy rains (Lwasa, 2010). In addition, malaria epidemics are reported to have increased in areas originally considered malaria-free zones in the south-western of Uganda e.g. in Kabale. A results of a study conducted in Tororo and Kabale districts indicates that with population increase and the predicted climate change the costs associated with malaria could double by 2050 (Twinomuhangi & Monkhouse, 2015).

Increased warming and flooding are likely to increase the prevalence and outbreaks of water borne diseases like schistosomiasis, cholera, dysentery, diarrhoea and typhoid. Schistosomiasis is a major health problem in Uganda (transmitted by snails) causing approximately 40,000 deaths per year and an estimated 8.5 million Ugandans were infected with the parasite in 2010. Flooding and increasing temperatures favour the parasite (USAID, 2014). Outbreaks of cholera are common in areas with poor sanitation, especially slum settlements, where flooding can cause potable water and wastewaters to mix. The wide spread use of pit latrines in urban areas increases vulnerability. In many areas pit latrines are shallow due to the high-water table in the valleys where slums are located. As a result, overflows occur and faecal matter mixes in the floodwaters and flows into shallow wells used for drawing drinking water. There have been numerous cholera and typhoid outbreaks in Kampala city in the recent past. Between 2003 and 2010, cholera outbreaks occurred every year, particularly during the rainy seasons that have increased floods in the city. In Kasese, cholera outbreaks have been reported in 2013 and 2017 after flood occurrences.

During drought, the population is predisposed to meningitis epidemics and other diseases caused by lack of water for adequate sanitation, such as eye and skin infections. Heat waves should also be a subject of concern, as increasing temperatures combine with the heat island effect associated with dense urban areas.

The vulnerabilities of the agricultural sector to climate change also exposes human health. When floods and drought lead to crop failure, the resulting food insecurity could culminate into malnutrition, which further erode resilience. Both malnutrition and HIV/AIDS have important consequences on peoples' resilience to climate change and extreme weather (USAID, 2014). The prevalence of HIV/AIDS is relatively high in Uganda, at 6% (Ministry of Health, 2017), and is more prevalent in urban areas. The high prevalence of HIV/AIDS increases climate change vulnerabilities because people with HIV/AIDS are less resilient. HIV/AIDS has also been associated with worsening of nutritional status, particularly among children (Nalwoga et al, 2010), a compounding challenge in the face of climate-induced food insecurity. HIV/AIDS decreases the body's capability to fight climate induced diseases like malaria and cholera, making people who are HIV-positive more sensitive to other health factors, more especially the children, pregnant women and the elderly (USAID, 2014). The predicted climate change exacerbates all the above situations, further worsening health of the urban population. There is need to develop climate early warning systems and put in place contingency plans for developing climate change–resilient health systems in urban areas.

Another pertinent urban health concern is air quality. Air pollution is an emerging serious health concern especially in Kampala and other growing centres in Uganda. Air quality is more related

to the energy use, especially combustion of firewood, charcoal and diesel which emit particles in the air that lead to respiratory illnesses for human beings such as allergies, sore throat, asthma, chronic bronchitis or pneumonia. The WHO recognises that air pollution is the largest single environmental risk and a leading cause of disease and death globally. Every year 4.3 million deaths occur from exposure to indoor air pollution and 3.7 million deaths are attributable to outdoor air pollution (WHO, 2015). Air quality is a risk factor for ischemic heart disease, stroke, chronic obstructive pulmonary disease, asthma and cancer. Air pollution's negative effect on health brings an enormous economic burden. A WHO report released 28 April 2015 reveals that many premature deaths are caused by air pollution in 2010 (WHO, 2015). During the 68th WHO Assembly held in May 2015, the WHO adopted a resolution to address air quality and health impacts of air pollution. The resolution highlights the key role national health authorities need to play in raising awareness about the potential to save lives and reduce health costs, if air pollution is addressed effectively. It urges Member States to develop air quality monitoring systems and health registries to improve surveillance for all illnesses related to air pollution; promote clean cooking, heating and lighting technologies and fuels; and strengthen international transfer of expertise, technologies and scientific data in the field of air pollution.

Currently, there are no air quality monitoring systems in Uganda's, even in urban areas. According to the 2009 ICF inventory, air quality degradation is mainly arising from households' open-air burning of waste, burning of charcoal and firewood; followed by transport due to dust from unpaved roads and from vehicle emissions especially from old cars (a big portion is imported from abroad without any control). The rapid increase in boda-bodas also has significantly increased their impact on air quality. According to KCCA, boda-bodas account for more than 40% of commuting trips in the city, but carry only 9% of passengers (KCCA, 2014).

Establishment of an air quality monitoring and assessment system is a strategic point in improving air quality, and more especially for transportation and planning. Air quality monitoring would determine when, which type of vehicles to access and in which areas, depending on the spatial distribution of air quality levels. Heavy goods vehicles would have to strategically be redirected away from air quality sensitive areas such as the CBD and residential neighbourhoods. Increasing the use of clean energy for cooking at household level will reduce burning of charcoal and firewood, while improving waste management to reduce open burning of waste is essential. It is also essential to promote public transport systems and non-motorized transport to improve air quality.

4.6.2 Education

Climate change has a direct and indirect impact on education. Extreme climate events that lead to floods, landslides and fires have direct impact on education facilities. For example, they can damage education infrastructure like schools. However, the vulnerabilities of other sectors indirectly expose education to the impacts of climate change. For example, climate impacts on the health of teachers and students affect the learning environment. The impacts of climate change on transport affects movement and access to schools. Learning requires energy for lighting and running equipment, and thus the impacts of climate change on energy supply indirectly affect education. Food and nutritional security are important for learning as they affect the health of learners and their ability to concentrate.

However, education is also critical in addressing climate change. The impact that human beings have on the environment depends on their understanding of the functions/services it provides to them and their ability to adapt to that environment. From a young age, children need to understand their relationship with the environment and learn to use it sustainably. Education is very important

in building resilience to climate change. Not only does education provide information on climate change risks and disasters and how to adapt, but it also builds skills to better understand the information provided and to seek resources to implement climate solutions (World Bank, Group, 2015).

In Uganda, formal education is not a function of local governments. Urban authorities can, however, make critical investments in in educating and skilling their workforce to address climate change in delivery of services. Urban authorities can also spearhead climate change education in institutions in their areas of jurisdiction. The school is the place where all begins. In the context climate resilience, the education approach has to go beyond the school curriculum and circles to involve all the actors that play a role in education. They can also engage in climate change education and public awareness campaigns to ensure that urban communities tap into climate smart livelihood opportunities. Exhibitions showing environmentally friendly and climate solutions such as producing renewable energy, energy efficient gadgets, eco-friendly building materials can be used to build awareness. Involving youth, young artists and influential personalities in eco-friendly activities is crucial in communicating climate messages and can deliver positive results.

In all it is essential that children are educated at school on the environment and the schools allow them to form associations or to develop projects. They choose the right words to deliver messages and are certainly most listened to as compared to the experts who are used to address messages to informed persons.

4.7 Ecosystems and the environment

Human societies derive many essential goods and services from natural ecosystems. Well-functioning ecosystems provide ecosystem services such as nutrient cycling, pollination, flow of clean water, regulating micro-climate, ensuring genetic diversity, waste assimilation, food, fibre, wood fuel, soil retention and formation and recreational services. The major ecosystems sustaining human life in Uganda are wetlands, forests, rangelands and water resources. Almost all the major sectors of Uganda's economy are linked or dependent in one way or the other on natural resources and ecosystems.

SDG15 urges all countries and societies *'to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation, and halt biodiversity loss'.* Indeed, target 9 is specific to the integration ecosystem and biodiversity values into national and local planning, development processes, and poverty reduction strategies. Target (a) requires countries to mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems. The Uganda Vision 2040 recognises that Uganda socio-economic transformation will only be achieved if the environment and natural resources are sustainable utilized and critical ecosystems are protected, and or restored. Environment is a crosscutting issue and the GoU planning guidelines requires all national, sectoral and local development plans, strategies, programmes and projects to integrate environment issues.

There is a linkage between climate change and ecosystems. Biodiversity and ecosystems are directly or indirectly affected by the concentration of atmospheric CO_2, temperature, rainfall, floods, droughts, etc. On the other hand, human activity exerts pressure on ecosystems through conversions of wetlands and forests. Uganda's ecosystems are under increasing pressure from rapid population growth and urbanization and the area coverage by forests and wetlands has declined significantly. However, forests and wetlands are important assets in the natural capture of carbon and thus mitigate GHG emissions and climate change. Thus, a reduction in forest and

wetland cover can have significant negative impacts in terms of increased GHG emissions and reduced delivery of ecosystem services. For example, 33% of Uganda's GHG emissions are from Landuse, Landuse Change and Forestry (LULUCF).

Healthy ecosystems play an important role in building the resilience of communities to the impacts of climate extremes and disasters. Thus, ecosystem degradation undermines the ecosystem protection function against natural hazards and disasters, including those related to climate change. The IPCC AR5 indicates that by the end of the 21st century, climate change may be the dominant direct driver of biodiversity loss and changes to ecosystem services globally. In Uganda, the projected warming, reduced rainfall and increased droughts will significantly affect biodiversity and ecosystems. Climate change also exacerbates ecosystem degradation, which in turn increases GHG emissions and triggers more humanitarian and environmental disasters, and reduces nature and societies' security and resilience.

4.7.1 Wetlands

Uganda has extensive coverage of wetlands, spread throughout the country especially around most of the lakes, rivers and streams. The wide coverage of wetlands is influenced by climate factors (high rainfall) and the general topography of the country that is dominated by flat low land surfaces (NEMA, 2009). Wetland ecosystems have been severely degraded and encroached on by agricultural, settlement and industrial activities, among others. For example, in 1994 wetlands covered about 15.6% of Uganda's land area but by 2008 the area covered by wetlands had reduced to 10.9% (NFA, 2009, Ministry of Water and Environment, 2012). Urbanisation is one of the drivers of wetland ecosystem degradation through conversion of wetlands into residential, commercial, industrial and agricultural use. The increased demand for sand and clay for the construction industry (associated with rapid urbanization in the region) has also increased wetland degradation.

The wetland catchment areas around Lake Victoria alone shrunk by more than half during between in 20 years (NEMA, 2010). In Kampala city, wetlands cover 8.3% (Ministry of Water and Environment, 2015b) having reduced from 15% of the total city surface area (KCCA, 2015). Between 1995 and 2010, wetlands in Kampala City, and Wakiso and Mukono Districts (which are predominantly urban and peri-urban areas) reduced by 14% (Ministry of Water and Environment, 2015b). The degradation of the Nakivubo wetland has reduced its capacity for water purification. This has resulted in algal blooms in the inner Murchison Bay and increased water treatment costs for NWSC and high-water tariffs for the Kampala population. The wetland is in further danger of being modified and converted completely, resulting in the total loss of wetland resources and services. In Entebbe Municipality, the area covered by wetlands is reported to have reduced by approximately 40% due to encroachments particularly in the periphery of the Municipality.

Although there is no data on the extent of wetland degradation in the other urban areas, encroachment on wetlands by development was reported in all urban areas. During stakeholder consultation in the selected urban areas, poor management of watersheds, encroachment on natural assets like swamps, green belts and open spaces for construction, quarrying and bricklaying, and forests mainly for charcoal were considered as main threats to the urban ecosystems.

Uganda recognizes the important role played by wetlands in the delivery of ecosystems services. Uganda's NDC priorities to increase wetland coverage from 10.9% in 2014 to 12% by 2030 through demarcation, gazettement and restoration of degraded wetlands. The NDP II has prioritised to restore the degraded fragile ecosystems (river banks, bare hills, range lands and lake shores).

4.7.2 Forest

Uganda's forest cover declined drastically from 54% in the 1950s to 24% in 1990 (NFA, 2009), and further declined to approximately 10% in 2015, an average decline of about 1.8% per annum (UBOS, 2015). Urbanisation is one of the drivers of deforestation through urban expansion on urban forests and as well as dependence on charcoal and firewood for cooking by the urban population. The projected increase in population and urbanization will further increase deforestation through urban sprawl and high demand for wood fuel. Whereas Uganda in its NDP aims at increasing forest cover to 21% by 2030, there is a challenge of providing alternative cheap alternative energy to replace charcoal and firewood for cooking (Government of Uganda, 2015b).

The Uganda National Forest Plan 2011/12 – 2021/2 priorities urban forestry to provide a wide range of environmental services and tangible benefits of goods needed by the urban population (Ministry of Water and Environment, 2013). The Plan recognizes that urban forests control urban flooding by reducing storm water run-off, urban soil erosion, and the swamps improve on quality of domestic water supply. However, politicians and urban authorities often view urban forests and tree planting as wastage of land for development. For example, in 1997 part of the Namanve Forest Reserve on the fringes of Kampala city (including a wetland) was degazzetted to form the Kampala Industrial Park (Ministry of Water and Environment, 2015b). Currently, some urban areas are in the process of degazetting Central Forest Reserves (CFRs) for urban expansion i.e Barifa CFR in Arua Municipality, and one in Entebbe Municipality, Loroo CFR in Gulu Municipality. Tree growing in urban and peri-urban needs to be encouraged to increase aesthetic and environmental values, provide wood products and provide opportunities for environmental education. It thus essential to integrate forestry in urban planning as it provides important entry-points for ensuring establishment and management of forest resources.

4.7.3 Greenbelts and open spaces

During stakeholder consultations with physical planners and environmental officers, increased conversion of greenbelts and open spaces for commercial, industrial and settlement development was reported as serious challenges in all urban centres. In Kampala city, the total green area is expected to decrease by 19% by 2020 and 29% by 2030 (Namalwa *et al.,* 2013). There is also recognition by the urban authorities that reducing green cover compromises the supportive, provisioning, regulative and cultural functions played by such areas. In addition, there is realization that unsustainable use and management of urban green compromises their contribution to diversity of urban character, vitality, vibrancy, biodiversity, recreation, tranquillity and tourism, livelihoods, social interaction, inclusiveness and safety. The potential of natural drainage systems to attenuate runoff has greatly also been impeded due to increased paving resulting from urban development and encroachment on natural drains. This calls for more investment in engineered drainage system is required if flooding is to be addressed.

Around Lake Victoria, wetlands provide ecological services that support small-scale income activities for slum dwellers such as papyrus harvesting, brick making, and fish farming. The wetlands also provide valuable wastewater purification and nutrient retention ecosystem services hence protecting Lake Victoria from pollution. In the past decade, the potential of the wetland to remove nutrients and pollutants has been greatly reduced due to continued encroachment. In Kampala, Bwaise, one of the densest settlements in the city is partly located within Lubigi wetland. The Nakivubo wetland is another threatened component of the Lake Victoria catchment system. It has been encroached upon by informal settlements and industrial development. Parts of the wetland in Kinawataka, Banda and Kyambogo have been encroached on by settlements and industries.

Despite the challenges faced arising from population growth and urbanization and their impact on wetland ecosystems, Uganda has made ecosystem protection and restoration a high priority and made it a pillar for sustainable development in Uganda Vision 2040. The benefits of healthy ecosystems should place ecosystem management at the heart of key policy decisions in all urban authorities. With the projected impacts of climate change - the heat waves, droughts and floods - it is vital that essential ecosystem services are maintained in order to protect vulnerable societies. By building resilience of natural and human systems, more ecosystems services can be used in a cost-effective way to support adaptation and disaster risk reduction, so reducing impacts from climate-related disasters. Urban authorities consider ecosystem-based adaptation an integral element of their strategic, physical and development planning.

4.8 Climate information and early warning systems

Planners and decision makers as well as practitioners in climate sensitive sectors have varying levels of understanding about climate change and related information. Yet, they need to make decisions on appropriate responses (actions, plans, investments, polices, and so on) to climate change (Future Climate for Africa, 2016). Given the country's high vulnerability climate change, decision makers and the wider public need reliable, accessible, and trustworthy information about climate and how this climate might change in future, if they are to plan and appropriately respond its impacts. Meteorological and hydro-meteorological information as well as early warning systems are essential to reducing vulnerability to climate hazards, disasters and extreme weather events. The key sectors that depend on quality climate information for risk management and adaptation include: transport, agriculture, water resources, energy, and health.

Uganda is still constrained when it comes to delivering quality climate data, information and knowledge. The Uganda National Meteorological Authority (UNMA), the agency mandate with climate observation and information dissemination, is constrained in this role by inadequate coverage of the meteorological network, human resource challenges and inadequate systems that hinder its ability forecast weather, and to monitor, detect and predict climate change. In addition, although MWE has put in place a Water Information System (WIS) to provide hydrological information, challenges and gaps still exist and the system needs strengthening (World Bank Group, 2015). Many urban areas do not have weather observation stations and have not developed early warning and disaster preparedness systems. Limitations on climate data, information and knowledge continue to constrain the make urban authorities' ability to manage or respond to climate risks and disasters.

5. MOVING TOWARDS CLIMATE RESILIENT URBAN DEVELOPMENT

5.1 Introduction

In this chapter, the responses to create more resilient urban systems are presented. The responses presented are based on the assessment of urban vulnerabilities to climate change and the current actions by urban areas to address the climate change challenges. The discussions build on the observed and projected changes in climate discussed in chapter three, and the climate change vulnerabilities discussed in chapter four.

5.2 Managing climate risks and increasing urban resilience

The NCCP seeks to promote urban planning and the development of resilient human that are robust enough to withstand climate change related risks and hazards. In view of the changing climate and its likely adverse impacts on urban systems, robust responses that address both the current and future climate change challenges and opportunities, enhance urban economies growth and alleviate urban poverty are necessary. The World Bank (2011a) posits that climate smart development can be achieved by adapting and mitigating risk selecting interventions from the **"three I's: *Information, Institutions and Infrastructure*.** This approach can be applied to urban climate change action, as discussed later in this chapter.

Climate change is embedded with uncertainties. Modelling climate variability and climate change is based on historic data and future assumptions. In Uganda, historic data for many parameters is often incomplete or the related time-series are short. Future predictions of population and economic growth vary widely, thus negatively influencing the reliability of climate models. Downscaling climate models to a local level, like urban areas in this case, increases the uncertainty of the model. Therefore, there is considerable uncertainty about how Uganda's climate, and that of the urban areas at a local scale, will change.

The recommendations made in this document take into consideration the complexity of dealing with uncertainty of future climate, especially when dealing large, inflexible investments or irreversible decisions like infrastructure projects that are very costly and have a long-life span (for example transport, energy, water, waste management and building infrastructures). Thus, urban plans, strategies and programmes, must have special qualities that take into account these uncertainties. Thus, urban infrastructure investments and investments in urban socio-economic systems must be 'resilient' i.e. able to withstand climatic, economic, environmental, and other shocks, and be able to recover and continue to function (World Bank Group, 2015).

Robust investments can help turn climate risks into opportunities for urban growth and poverty reduction, and the benefits can outweigh the costs of inaction. Most urban investments related to climate change, though costly, will also address urban development and poverty reduction related challenges. For example, investments in green energy and sustainable urban transport systems will deliver multiple benefits: increase energy security, improve mobility, increase investments, create jobs, and improve incomes, and improve health and welfare while at the same time building climate resilience. Some examples of robust investments in urban areas can include clean water supply, resilient transport networks, renewable energy, forest and wetland conservation, improved health and education services, among others.

The prioritisation of climate smart urban development options in this document follows, but is not limited to, the principles developed by Willows and Connell (2003); and further elaborated by World Bank (2011); World Bank 2012; and Government of Uganda (2013). Importantly they address the adaptation and mitigation co-benefits and triple wins (development, resilience, and low emissions)[5].

- ***Win-win options.*** Options and combinations of options that mitigate the risk (in part or in whole) and are cost-effective. In this context, a comprehensive approach to urban development would include options that considering current and future climate, and additional options that enhance the resilience of the urban systems (mobility, energy, water etc).
- ***No-regret options.*** Options that are cost-effective, enhance productivity and resilience, and provide benefits under the current and future climate scenarios i.e. leave no regret if the actual path of climate change creates little or no additional risk above what would be expected from historical variability.
- ***Low-regret (or limited regret) options.*** Options with modest cost but whose benefits, which may be very large, are actually realized only if the projected changes occur. Because of the low cost and the uncertainty involved, these options take an insurance-like approach when the likelihood of the vulnerability seems large (in terms of overall harm to project outcomes).
- ***Flexible (scalable, adjustable) adaptation options.*** Options that can be designed to be scalable or adjusted in the future as the actual path of climate change emerges. Water and energy supply systems or can be scaled up if this approach is adopted at the beginning. Research is another example of an option that can be scaled up or intensified, or its direction changed, as future conditions emerge and improved monitoring systems better detect them.
- ***Ecosystem based approach:*** As derived from Government of Uganda (2013), climate change response in urban areas have to take into consideration that that some urban development options should be identified and developed on a larger scale, i.e. going beyond the usual administrative boundaries. The wider approach suggests that an entire ecosystem should be the basis for sustainable approaches: a watershed/ecosystem approach is essential to tackle flood risks, water quality/security, ecosystem health and continued delivery of ecosystem services (UNDP, 2013). In other words, ecological goals need to be treated equally to and simultaneously with economic and social goals[6]. More recently, the ecosystem based adaptation approach (EbA) is preferred.

5.2.1 Information responses

The NCCP foresees the need to disseminate climate-change and early-warning information in local languages to improve community disaster preparedness. Urban authorities lack reliable and updated climate data information and knowledge base but these are vital for the planning and management of urban systems. For any urban territory to address climate change, its necessary to have a better knowledge of the climate change risks and hazards as well as the vulnerabilities and appropriate adaptation actions for the urban territory. Thus, climate data collection, assessment

5 The adaptation and mitigation co-benefits highlights that addressing climate change challenges through only one lens (either mitigation or adaptation) can lead to trade-offs and one could undermine the other. However, building synergies between adaptation and mitigation is more cost-effective and beneficial as it can increase climate resilience, accelerate development and poverty reduction while at the same time reducing emissions with all the associated benefits: improved air quality, improved health, increase energy and water security, increased incomes, creation of jobs etc.

6 Urban development projects should be designed in a way that does not compromise ecosystem health but should essentially enhance enhances it. Ecosystem based approaches would necessitate collaboration between urban authorities and neighbouring local authorities. Economic development and land use planning at strategic level, together with constant monitoring and evaluation, and infrastructure development should guide the urban development projects.

and information, education and communications need to be strengthened and linked into physical planning and urban development.

Currently, UNMA is upgrading its meteorological services and it is important the urban areas are taken into consideration to improve weather and climate observations for local use and climate data coordination with user communities. MWE's hydrology information services also need to take into urban needs into consideration. Improvement in weather forecasts and real-time decision support systems for operational and flood management would enable better manage floods and droughts. It is also essential that urban authorities to not only have reliable climate projections but also strengthen climate early warning and disaster preparedness systems.

It is essential to collate knowledge base on climate variability and change, impacts, vulnerability, and adaptation options related to urban systems. This kind of systematic knowledge collation, which is currently absent, is critical for urban planning and implementing any climate change plans and strategies. Addressing climate change requires partnerships between the scientific and development communities. Improve knowledge partnerships and collaboration between the academia, researchers, policy makers and development communities are crucial. This is essential to ensure both that the latest scientific advances are reflected in urban development programmes and the scientific questions explored are shaped by urban development needs and decisions. Developing urban climate and meteo-information systems to inform and sensitize the urban population on climate risks and hazards like storms, floods or droughts risks will go a long way to build climate resilience and enhancing urban economies.

5.2.2 Institutional Responses

Although Uganda has put in place an elaborate policy and institutional framework to address climate change, more effort has been placed at the national level, and little exists at the local level and specifically for urban authorities. At the national level a National Climate Change Policy and NDC are in place and both of them prioritize building resilient urban systems and achievement of green cities. One of the priorities of the Uganda GGDS is building 'green cities' and 'sustainable cities'.

Addressing climate change at the local level is greatly constrained by policy gaps. Apart from Kampala city, all the urban areas do not have a policy to guide climate change response. A review of the 5-year Development plans and Physical Development Plans reveals that all the urban areas have not incorporated climate change in urban development plan. No Municipality or Town Council has incorporated an assessed the climate change related risks and hazards and how to address them in their plans and budgets.

In addition, apart from Kampala city, no other urban authority has developed a stand-alone or elaborate climate change strategy or action plan. The opportunity is that OPM (Disaster Preparedness and Refugees) has conducted multi-hazard risk and vulnerability assessment across the country and this can be a starting point. But still, urban authorities will have to conduct detailed climate change vulnerability assessments across their territories, and only KCCA has conducted such a detailed vulnerability assessment that also covered some issues in the Greater Kampala Metropolitan Area.

Currently the EU is supporting KCCA to implement a climate change project entitled *'Kampala Climate Change Action Strategy: Developing and sharing the low carbon and climate resilient Kampala'.* The project assistance is for supporting KCCA to implement its climate change action plan but in addition, the project is also building the capacity of municipalities and urban centres in

GKMA to develop and implement their own Sustainable Energy and Climate Change Action Plans (SEACAPs). The project is being implemented in collaboration with Entebbe, Kasese and Mukono Municipalities.

At the national level, the Climate Change Department (CCD) is mandated to coordinate climate change in the country. However, CCD is constrained in terms of human and financial capacity to coordinate climate change response at the national level and extend to the local level. Within the urban authorities, there is no clear institutional framework to handle climate change. At the local level the climate change mandate lies within the Natural Resources Departments but they are financially constrained to carry out this mandate. Most of the Environment Officers have not have climate change training as do the Physical Planners and Economic Planners and yet these officers are supposed to lead climate change mainstreaming in the urban authorities.

Urban authorities have a jurisdiction over landuse i.e. through physical planning and development control. Thus there is a lot that urban authorities can do, through policy, to build resilience: landscape policy, building standards, eco-neighbourhoods to reduce urban sprawl and to improve the design and construction of resilient buildings. But this can only be achieved through a strong cooperation with national authorities. Although urban authorities may not be in direct control of energy or water distribution networks but through their physical planning responsibility and landscape policy, they a significant role to play in influencing the national utility agencies to take into account climate change resilience in their activities. Still urban authorities can through physical planning and development control ensure that developers take into account renewable energy installation, water harvesting and sanitation.

A lot can be done to improve the urban institutional effectiveness to address climate change.

ix. The starting point is to build the urban authorities' strategic capacity to address climate change, starting with human resources - technical staff and decision makers. This should involve training urban technical staff in climate change especially: the environment officers, physical planners, economic planners, municipal engineers and community development officers. It is also essential to raise climate change awareness among the political leaders and decision makers. This will help to pitch climate change at higher level in the planning and decision-making.

x. Establish an institution/office to spear head and coordinate climate change response in the urban authorities. Climate change is a cross-cutting issue that needs to be integrated in all plans and budgets, and thus requires strong institutional framework for coordination and enhancing collaborations between the different departments and sectors. This will help to build on the complementarities between the different department and interventions in the urban authorities.

xi. Uganda is developing a National Physical Development Plan. It is the opportunity to ensure that climate change concerns are integrated in the physical planning and development control at national level and then be translated into climate proofed physical development plans within municipalities and town councils.

xii. Develop specific/standalone climate change strategies or action plans. The elaboration of climate change plans for urban authorities as of necessity be highly participatory involving detailed vulnerability assessments and prioritization of actions/options specific to the urban territories that cut across the adaptation and mitigation divide. In other words, the prioritized response actions deliver adaptation-mitigation co-benefits and triple wins

i.e. foster urban socio-economic development, climate change resilience and low carbon development.

xiii. Integrate/mainstream climate change in Municipal Development Strategies, 5-Yaer Development Plans, Physical Development Plans, and other sector specific plans and programmes: water and sanitation, energy, transport, environment management, waste management, health, education.

xiv. Revising building design codes and standards to address climate change risks.

xv. Mobilize climate change finance. This can be through budgeting, but also by accessing external climate finance. To achieve this the capacity of urban authorities to develop bankable projects needs to be unenhanced. Urban authorities needs increased ability in project development and implementation

xvi. Build strategic partnerships with national and local level institutions as well as intercity (urban to urban) collaborations. Strategic partnerships with NGOs, private sector, universities and research institutions are very essential for climate change planning, training and mobilizing climate finance.

5.3 Infrastructure responses

There is need to build climate resilient urban infrastructure. The discussions in chapter three centred on the poor state of urban infrastructure and utilities and their vulnerability to the impacts of climate change: energy, transport, water, sanitation, health etc., as well as management programmes such as environment and ecosystem management. Climate proofing urban infrastructure will be very important in a changing climate:

- Critical investments in water infrastructure to ensure water security taking into account a changing climate: from rainwater harvesting to large water storage recognizing that water availability and water quality require an ecosystem based approach involving water catchment protection and ecosystem management that extend beyond the urban territories.
- Investments in renewable energy installations and energy efficiency at household and institutional level to ensure energy access, energy security and reduce GHG emissions. These could include solar installations for households and institutions, solar street lighting, efficient energy cook stoves and LPG for cooking. Urban authorities can work with energy utilities to extend electricity coverage in urban areas.
- Climate proofing existing and future transport infrastructure like roads, rail and bridges, as well as climate resilient buildings and social infrastructure (eco-buildings and eco-mobility).
- Increased investment in flood control infrastructure and wastewater management/drainage. This will involve redesign, reconstruction and realignment of drainage infrastructure taking into consideration a changing climate.
- Strengthened capacity to prepare climate resilient plans and investments is also required. This could involve building capacity of urban authorities to develop climate change projects
- Software investments are required i.e. climate change research, developing and communicating climate knowledge, and coordinating research on interactions and impacts between climate and the urban sectors.

Sector specific climate change responses are provided in Table 13.

Finally, the study recommends that a programme for building urban climate change resilience in Uganda be developed and implemented. A programme concept note has been developed and appended to this report as Annex 1.

Table 13: Sectoral climate change responses

Sector	Main challenges/vulnerabilities	Information responses	Institutional responses	Infrastructure responses
Energy	• Dependence on hydropower, which is sensitive to climate change: rising temperatures, droughts that lead to reduced water levels. • Energy supply chains are vulnerable to disruptions caused by extreme weather events – storms and floods. • High dependence on traditional biomass energy (charcoal and firewood) for cooking - climate sensitive and leads to deforestation and GHG emissions • Urban authorities have no control over energy supply and networks • Energy supply is unreliable (load shedding) and coping is switching to thermal which affects air quality and increases GHG emissions • Low rates of adoption of renewables energy sources. • Unreliability of electricity supply and the energy tariffs/cost that make it unaffordable for cooking	• Raising awareness on the needs, eco-friendly/climate smart energy solutions and energy efficiency • Conduct energy assessments to determine current and energy demand and supply, and the potential impacts of climate change on energy. • Analysis of energy potentials including renewables and avenues for their development.	• Develop an energy master plan for each municipality • Institutional coordination between urban authorities, energy utility agencies and Ministry of Energy • Policies and incentives to increase renewable energy installations • Institutional capacity development within urban authorities for integrating physical planning and energy planning. • Create specific departments of energy in urban authorities to manage energy issues in urban territories (public buildings and facilities, vehicle fleet, street lighting, energy management system, data collection and analysis).	• Increase renewable energy installations in homes and institutions like solar panels. • Solar street lighting • Invest in solar powered generators at critical installations to replace diesel generators that have significant impact on air quality and GHG emissions • Invest in cooling strategies e.g. green roofs, white roofs, strategically planted trees, green walls and urban greening. • Energy efficiency: energy cook stoves. Energy efficient buildings
Transport and mobility	• Transport infrastructure (roads and bridges) built not taking into account future change in climate. • Urban transport networks are in poor state and are less resilient to the impacts of climate change – potholes, unpaved roads, no drainage channels	• Mapping of areas and facilities at risk of flooding and their consideration in physical development plans • Use of information systems based on weather forecast to manage traffic and put in place a dedicated decision-	• Work with national and local authorities to integrate climate change into existing national and local transport policies, plans, standards and guidelines. • Develop urban eco-	• Climate proof existing and future transport infrastructure (roads, bridges, rail) taking into account climate change • Address drainage and storm water management: put in place and implement urban drainage master plans.

Sector	Main challenges/vulnerabilities	Information responses	Institutional responses	Infrastructure responses
	• Floods and storms damage transport infrastructure. Droughts and heat waves increase dust • Lack of public transport and increase in private motor vehicles lead to traffic congestion, poor air quality and increased GHG emissions.	making process to manage the risk when it occurs.	mobility plans in consultation with all stakeholders. • Work with national entities to ensure vehicle fuel efficiency - cars and motorcycles environmental performance standards.	• Develop public transport and eco-mobility: Bus Rapid Transit Systems, non-motorized transport, traffic controls
Housing and the built-up environment	• The main vulnerability is related flooding risks • Inadequate physical planning and development control that does not factor in climate change reduces urban resilience. • Increased encroachment on wetlands, green belts and open spaces by urban developments • Slums and informal settlements located in high flood risk locations and lack the requisite infrastructure and services • High urban poverty means less resilience to climate risks and disasters. • Lack of climate proofed buildings/ facilities, and construction and renovation standards	• Flood hazard and risk mapping to understand the vulnerabilities of built up area to flooding. • Developing climate and meteo-information systems to inform and sensitize the urban population on climate risks and hazards	• Integrate climate change in urban/physical development plans, strategies and guidelines. • Develop design standards and building and zoning codes that are eco-friendly and address the impacts of climate change. These might include no build zones, renewable energy incentives, rainwater harvesting, green building requirements etc. • Improve coordination and the collaboration between national and local authorities/ utilities to better respect policies, land use plans, regulations issuance of permits etc. • Develop eco-guidelines to guide developments, most especially in highly environmental sensitive areas	• Slum upgrading that takes into account climate risks • Implement a citywide/urban green infrastructure programs to increase urban greening through a green area factor ranking system i.e. trees and other vegetation absorb many air pollutants and also reduce impervious surfaces. • Encourage the construction of eco-friendly housing, more especially for the urban poor who reside in high-risk areas. • Imposing a minimum portion (%) of green surface at the plot level, minimum use of renewable energy, rainwater harvesting etc.

Sector	Main challenges/vulnerabilities	Information responses	Institutional responses	Infrastructure responses
			• Integrating climate change, energy efficiency and renewable energies issues in the Environment Impact Assessments (EIAs)	
Water resources and water supply	• Access to clean and safe water: About 8% of urban population draw water from unprotected sources like rivers, streams, ponds, and lakes that are more likely to carry disease causing agents. • Water availability is affected by droughts and heat waves, • Floods, storms and even droughts affect water quality. • Melting of ice on Mt. Rwenzori is affecting water availability. • The mandate for urban water production and water supply is managed at national level, (NWSC), and not by the urban authorities. • Land and ecosystem degradation affects water quality and quantity and accelerates climate change vulnerabilities • Water pollution from urban industrial activity, poor sanitation and waste management practices	• Collect and disseminate reliable hydro-meteorology information i.e. climate information and early warning systems for flood/ drought forecasting and management • Ecosystems and wetland mapping linking to hydrological cycle.	• Develop capacity of technical officers (water, natural resource management, engineers etc) to address climate change in water resource development and management. • Develop and adopt green landscaping policy that can reduce pollution and improve water quality (water-efficient landscaping). • Conduct drought and flood planning and preparedness • Conduct river basin catchment protection planning • Develop and implement catchment management plans	• Strengthening hydro-meteorological infrastructure (increasing network coverage, upgrading networks) • Strengthen sustainable land and water management: wetlands protection and restoration; watershed management • Put in place flood protection infrastructure – dams, drainage channels • Invest in climate proofed water infrastructure – water harvesting, and water storage: e.g public buildings, households etc. • Promote water efficient consumption and services- new development projects should demonstrate water efficiency in a projected climate.

Sector	Main challenges/vulnerabilities	Information responses	Institutional responses	Infrastructure responses
Sanitation and waste water	• Poor sanitation conditions: very low coverage of the main sewer network (8%) in towns, 74% use pit latrines and 2% do not use any toilet facilities. • Inadequate wastewater treatment facilities in all towns. Discharge wastewater into the wetlands and lakes are key drivers of degradation and loss of ecosystem services. • High vulnerability to water contamination in a changing climate - especially floods and rain storms . • During heavy rainfall and floods there are outbreaks of water borne diseases like cholera, typhoid and dysentery.	• Conduct climate projections (rainfall) to ensure that future planning efforts around water and sanitation are based on most up to date climate models. • Collect and disseminate data on potentials of waste to energy recovery programmes	• Build partnership with relevant authorities – MWE, NWSC to better manage sanitation and waste water • Put in place a framework and strategy to develop local natural/technical waste water treatment systems	• Work with NWSC to extend sewer lines to communities to reduce on numbers of households using pit latrines • Develop centralized and/or small-scale local natural/technical treatment systems. • Increase the volume of fecal sludge from pit latrines collected by urban authorities • Increase the coverage of eco-san toilets for public use and in schools • Invest in waste to energy recovery - from wastewater, toilets, pit latrines, sewage etc.)
Solid waste management	• Waste sector is one of major emitters of GHG emissions (methane) and a driver of climate change. 84% of urban solid waste is organic • About 50% of waste is uncollected and disposed of. Open dumping blocks drainage channels causing flooding and water contamination. • Open burning of waste causes air pollution/affects air quality. • Inability to sort solid waste at generation points which hinders waste recovery, reuse and recycling.	• Information on impact of SWM on flooding/flood risk mapping • Survey on waste generation and types of wastes to inform waste management planning • Survey with national authorities and private sectors to assess the existing recycling activities/ industries/capacities to develop downstream a wider strategy for recycling. • Increase awareness raising campaign on sustainable	• Develop and implement/ enforce SWM strategies/ plans/ordinances: that cover sorting of waste, 3Rs, waste collection, citing and maintenance of disposal/treatment plans, no citing of SWM facilities flood-prone zones, waste to energy etc.	• Target to increase waste collection to say 90% (waste collection skips, vehicles etc.) covering all areas of towns. • Engage in investments to convert waste into energy and other uses - landfill gas, incinerators • Expand waste composting to all municipalities, since a lot of the waste is organic. • Put in place facilities to strengthen waste minimization programmes: i.e. waste separation and 3Rs.

Sector	Main challenges/vulnerabilities	Information responses	Institutional responses	Infrastructure responses
		SWM practices among the public, private and community actors, emphasizing sorting of waste and the 3Rs (recovery, reuse and recycling)		
Urban economy/ Green economy	• High urban poverty reduces resilience i.e. consequences of poverty on access to food, housing, services and health. • Urban poor reside in slums, which are prone to hazards e.g. floods, disease epidemics, fires etc. • Heavy depended on food supply from outside urban areas (hinterland), which are also affected by droughts, storms and floods in the producing area. These affect food availability, access and affordability. • Transporting of food from hinterlands increases GHG emissions. • Urban agriculture, on which urban poor depend, is prone to droughts and floods. • Most of the farming is done in drained wetlands, which are probe to flooding and pollution. • Land available for urban agriculture is dwindling at a fast rate due to urban sprawl. • Urban tourism activities are negatively affected by climate change - heat waves, changing rainfall	• Assess potential from green jobs from the formal and informal sectors. • Survey of the waste management sub-sector looking at the potential for recovery and recycling as avenues for job creation. • Flood risk mapping to identify areas at risk. • Drought forecasting and early warning and disaster preparedness • Climate adaptive research on opportunities and constraints for urban agriculture, urban tourism, fishing. • Climate information and knowledge base on urban adaptation by farmers, traders, touristic activities, industrialists and fishing communities	• Develop and implement urban agriculture policy, green tourism policy (existing policies could be reviewed to cater for these issues) • Climate response planning and capacity building for different economic activities in urban areas • Put in place advisory services on climate change and disaster management: water management, flood management, urban agriculture, fishing, tourism, industry, trade etc. • Invest in financial risk management, especially insurance, micro-finance, community saving and loan schemes etc. to help recovery from disasters.	• Supporting investments in small farming, organic farming, training farmers in eco-friendly urban agriculture activities. • Support the creation of SME on green economy / helping business access capital condition on eco-friendly practices and environmental performance • Engage in environmental and energy certifications and labels in different sectors such as urban agriculture, industry, tourism, services etc. (ISO 14001 and ISO 50001 • Climate proofing infrastructure to increase reliance of economic activity: transport, water, energy etc. • Support the development of green tourism activities – eco-friendly approaches, (energy, water, waste, eco material, biodiversity, mobility…). • Put in place specific programs that target employment and business enterprises of women,

Sector	Main challenges/vulnerabilities	Information responses	Institutional responses	Infrastructure responses
	patterns, floods, as well destruction of urban green (ecosystems), which reduce the attractiveness of tourist destinations. Some hotel businesses and tourist sites as well as the transportation of tourists are affected by floods. • Trade and other commercial activities are affected by the impacts of climate change, especially floods that lead to loss of business. For example most of the trade areas in Kampala are in flood prone areas. Floods also affect mobility and transport, which in turn affects trade. • Industrial activity is affected by climate change e.g. supply of raw materials to agro-based and fishing industries, water availability, and transportation of raw materials and finished products is affected by floods. Many industrial areas are located in high flood risk areas. Unreliable electricity supply cause by climate variability and extreme weather events negatively affects manufacturing activities • Fishing is affected by climate change e.g. the impacts of droughts on water levels and fishing activities			youth and marginalized groups and communities with specific attention to green city development. • Put in place specific eco-funding or eco-condition existing grants and loans provided for the starting of new enterprises taking into the climate resilience, energy efficiency, water efficiency and sustainable waste management. • Invest in eco-industrial/business parks dedicated to green activities that could innovate, demonstrate, and train in green activities and offer training to SMEs.

Sector	Main challenges/vulnerabilities	Information responses	Institutional responses	Infrastructure responses
Ecosystems and biodiversity	• Climate change is direct driver of biodiversity loss and changes to ecosystem services. • Ecosystems are under increasing pressure from rapid population growth and urbanization. • Encroachment on wetlands and other ecosystems is very high • Reduction in wetland cover leads increased GHG emissions and affects delivery of ecosystem services. It also increases the urban heat island effect. • Ecosystem degradation undermines the ecosystem protection function against floods and other natural hazards, including those related to climate change.	• Conduct economic valuation of ecosystems and ecosystem services and green accounting • Vulnerability assessment of different ecosystems to impacts of climate change. • Site specific adaptation/ management options for different ecosystems and biodiversity.	• Integrate ecosystem and biodiversity management in all urban development plans and programmes • Work with national entities to strengthen ecosystem protection and restoration, including stopping settlements and developments in wetlands • Increase local funding for ecosystem management • Develop site specific ecosystem based adaptation plans • Strengthen the enforcement of environmental/ecosystem management laws and regulations.	• Adopt ecosystem based adaptation (EbA) approaches to urban development and management. • Gazette, protect and restore critical wetlands and other ecosystems that support urban drainage systems. • Implementation of site specific ecosystem based adaptation plans • Encourage community-based conservation for maintaining ecosystem health and biodiversity. • Livelihood diversification to educe dependence of urban communities on ecosystems. • Develop green parks integrated with ecotourism, recreation and sustainable urban drainage systems • Engage in greening of urban infrastructure (drainage channel banks, roads, housing, urban beautification etc.) to make them eco-friendly and climate resilient.

Sector	Main challenges/vulnerabilities	Information responses	Institutional responses	Infrastructure responses
Urban forestry	• Climate change is direct driver of forest loss, habitat loss and forest fires • Urban forests are under increasing pressure from rapid population growth and urbanization e.g Namanve forest was degazzetted in 1997. CFR in Arua, Gulu and Entebbe are in the process of being degazzetted. • Area coverage by urban forests has declined significantly. • Reduction in forest cover leads increased GHG emissions and affects delivery of ecosystem services. • Forest degradation undermines the ecosystem protection and leads to urban heat island effect.	• Impact of future climate change on urban forests • Economic valuation of urban forests • Tree species assessment to prioritize species that are suitable in a changing climate.	• Develop an urban tree-plating guide to inform and encourage the planting of trees that withstand a changing climate. The guide should be promoted for use beyond street trees and be applicable for all public and private tree planting. • Put in place incentives for tree planting and/or include tree planting in building standards and codes at plot level.	• Intensify urban tree-planting programmes: along streets, public institutions and private. This should cover tree health and diversity of tree species. • Promote community led tree planting and afforestation through programmes like REDD+ • Protection of urban forests from degradation • Increase green cover and trees on lowland areas and hilltops as a way of increasing tree cover and habitats for biodiversity. • Intensify go green campaign with the planting of trees in open spaces the in towns.
Public health and air quality	• Increased temperatures will increase the burden of malaria • Increased warming and flooding are likely to increase the prevalence and outbreaks of water borne diseases like schistosomiasis, cholera and typhoid. • Drought increase exposure of the population to meningitis epidemics and other diseases caused by lack of water for adequate sanitation, such as eye and skin infections. • Droughts and floods negatively affect agricultural production causing food insecurity and malnutrition hence poor human health.	• Continue to assess the current and future impact of climate change on public health • Increase monitoring and surveillance of diseases and mortality in areas at risk e.g. slums. • Identify and map vulnerable locations and populations and establish hotlines in case help is needed. • Put in place early waning systems and emergency plans for climate related diseases/disasters	• Enhance the capacity of medical/public health staff to appreciate and address climate change issues in health service delivery. • Collaborations among actors on climate change and public health planning and response • Develop response plan with strategies to mitigate climate related health impacts • Put in place rapid response teams to detect and respond to disease	• Increase investments in disease prevention and health service delivery especially those related to climatic factors. • Conduct educational campaigns focused on engaging citizens, businesses and institutions on risks associated with heat waves, floors, and the need for climate change resilience practices and initiatives. • Use media outlets to increase awareness of risk associated with poor air quality - target at-risk populations and outdoor workers. • Encourage urban agriculture for sustainable local food production - small scale and organic food production with in the urban

Sector	Main challenges/vulnerabilities	Information responses	Institutional responses	Infrastructure responses
	• Air quality challenges arising from use of charcoal and firewood cooking, thermal energy, use of old vehicles, dust from unpaved roads, open burning of waste which cause respiratory diseases, but also increasing GHG emissions • High HIV/AIDS prevalence which reduces resilience to climate change impacts • Floods have impact on health infrastructure e.g. hospitals, mobility of patients and medical personnel. • Poor hosing designs without adequate access to natural light, lightening arrestors, poor ventilation, as well as asbestos and painted roofing.	• Increase monitoring and treatment of HIV/AIDS. • Air quality monitoring.	outbreaks	areas and surrounding region taking into account adaptation to climate change (backyard and rooftop vegetable gardens, community gardens and the preservation of productive agricultural lands, including vacant urban land). • Increase support and treatment of HIV/AIDS to increase resilience. • Improve drainage, sanitation, waste water management and clean water supply to reduce outbreak of climate related diseases • Invest highly in clean energy for cooking in households, vehicle efficiency and sustainable waste management practices
Education	• Extreme events that lead to floods, landslides and fires have direct impact on education facilities - damage education infrastructure like schools. • Climate impacts on and food security and health of teachers and students affect the learning environment. • The impacts of climate change on transport affects movement and access to schools. • Climate impacts on energy affects lighting in education institutions and running education equipment indirectly affect education.	• Build a climate change knowledge base: climate knowledge management, materials on climate change basics • Develop and operationalize curricula and training materials on climate change for primary, secondary schools and tertiary levels.	• Put in place climate change knowledge centres. • Put in place a platform and forums for raising climate change awareness. • Develop capacity for climate change training and learning – trained trainers	• Invest in climate proofed education infrastructure – schools, laboratories and training centres. • Encourage eco-friendly services and utilities in education institutions- renewable energy and energy efficiency (solar, biogas, efficient cook stoves, LED lights), water harvesting and water efficiency, eco-sanitation, waste bins for waste management etc. • Support the creation and the creativity of Environment/climate change clubs in schools and

Sector	Main challenges/vulnerabilities	Information responses	Institutional responses	Infrastructure responses
	• Education is critical in addressing climate change and building resilience. The impact that human beings have on the environment depends on their understanding of the functions/services it provides to them and their ability to adapt to that environment.			improve linkages between the clubs and management. • Engage creation of climate change champions in schools to promote best practices at schools with championship promotions and awards for the winners.

6. REFERENCES

Allison, E.H., Perry, A.L., Badjeck, M.C., Adger, W.N., Brown K., Conway, D., Halls, A.S., Pilling, G.M., Reynolds, J.D., Andrew, N.L. and Dulvy, N.K., (2009). *Vulnerability of national economies to the impacts of climate change on fisheries.* Fish and Fisheries10:173-196.

Asian Cities Climate Alliance, 2014. Vulnerability profiling of cities: A framework for climate-resilient urban development in India. Working Paper Series 8: 2014.

Awange, J. L., Ogalo, L., Kwang-Ho, B., Were P., Omondi P., Omute, P., & Monica Omullo, M. 2008. Falling Lake Victoria water levels: Is climate a contributing factor? Climatic Change 89, No. 3-4 (2008): 281-297.

Baastel, 2015a. Economic assessment of the impacts of climate change in Uganda: Infrastructure sector report. Ministry of Water and Environment, Kampala Uganda.

Baastel, 2015b. Economic Assessment of the Impacts of Climate Change in Uganda: Kampala Case Study Report. Ministry of Water and Environment. Kampala Uganda.

BBC (2016) 'Climate change: 2015 'shattered' global temperature record by wide margin' *BBC News*, 20 January 2015: In UN Habitat, 2016b. World Cities Report 2016: Urbanisation and Development – Emerging Issues. United Nations Human Settlements Programme (UN-Habitat)

Bloomberg, M. R, C40 Cities & Stockholm Environmental Institute, 2014. Advancing climate ambition: cities as partners in global climate action. http://c40-production-images.s3.amazonaws.com/researches/images/25_Advancing_Climate_Ambition.original.pdf?1412878084

Brown A.M. 2012. Uganda's new urban policy: participation, poverty, and sustainability. Sustainable Futures: Architecture and Urbanism in the Global South Kampala, Uganda, 27 – 30 June 2012. Available at: http://sfc2012.org/brown.pdf

Bwambale, T., & Waiswa, J., 2017. Sewage plant to produce electricity opens in January. The New Vision. Monday, August 14th 2017. Kampala Uganda.

Climate and Development Knowledge Network (CDKN), 2014. The IPCC's Fifth Assessment Report. What is in it for Africa? Available at: https://cdkn.org/wp-content/uploads/2014/04/AR5_IPCC_Whats_in_it_for_Africa.pdf

Endris, H.S., Omondi, P., Jain, S., Lennard, C., Hewitson, B., Chang'a, L., Awange, J.L., Dosio, A., Ketiem, P., Nikulin, G., Panitz, H.-J., Büchner, M., Stordal, F., Tazalika, L. (2013). Assessment of the performance of CORDEX regional climate models in simulating East African rainfall. *J.Clim.,* 26 (21), pp. 8453-8475, DOI: 10.1175/JCLI-D-12-00708.1

Energypedia.info. Uganda Energy Situation:

https://energypedia.info/wiki/Uganda_Energy_Situation#Energy_demand: Accessed 27th September 2017

Government of Uganda, 2000. National programme for good governance in the context of the Poverty eradiation action plan (PEAP). Uganda governance capacity assessment project. Ministry of Finance, Planning and Economic Development. Kampala Uganda.

Government of Uganda, 2013. The Integrated Territorial Climate Plan (2014-2029) for the Mbale

Region of Uganda.

Government of Uganda, 2010. Uganda Vision 2040. National Planning Authority. Kampala Uganda.

Government of Uganda, 2014a. Poverty Status Report, 2014. Ministry of Finance, Planning and Economic Development. Kampala Uganda.

Government of Uganda, 2014b. Uganda Second National Communication to UNFCCC. Ministry of Water and Environment. Kampala Uganda

Government of Uganda (2015a). Second National Development Plan 2015/2016 – 2019/2020. National Planning Authority. Kampala Uganda.

Government of Uganda, 2015b. Uganda's Intended National Contribution to UNFCCC. Ministry of Water and Environment.

Government of Uganda, 2016a. The National Population and Housing Census 2014 – Main Report, Uganda Bureau of Statistics Kampala, Uganda.

Government of Uganda, 2016b. The National Housing Policy. Ministry of Land, Housing and Urban Development. Kampala Uganda.

Government of Uganda, 2017a. Strategic programme for climate resilience: Uganda pilot programme for climate resilience. Ministry of Water and Environment. Kampala Uganda.

Government of Uganda, 2017b. The Uganda green growth development strategy 2017/18 – 2030/31. National Planning Authority. Kampala Uganda.

Government of Uganda, 2017c. Uganda National Urban Policy 2017. Ministry of Lands, Housing and Urban Development, Kampala Uganda.

Intergovernmental Authority on Development (IGAD). 2010. *IGAD Environment Outlook*.

IPCC. 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Summary for Policy Makers.

IPCC, 2013. Climate Change 2013: The Physical Science Basis, Summary for Policy Makers.

IPCC, 2014. Climate Change 2014: Impacts, Adaptation and Vulnerability: Chapter 22, Africa.

Kampala Capital City Authority, 2014. KCCA Strategic Plan 2014/15 – 2018/19

Kampala Capital City Authority, 2015a. Kampala Climate Change Action. Available at: https://www.kcca.go.ug/uDocs/Kampala-Climate-Change-Action.pdf.

Kampala Capital City Authority, 2015b. KCCA Energy and Climate Profile.

Kalognomou, E-A, Lennard, C., Shongwe, M., Pinto, I., Favre, A., Kent, M., Hewitson, B., Dosio, A., Nikulin, G., Panitz, H-J and Büchner, M. (2013) A diagnostic evaluation of precipitation in CORDEX models over southern Africa. *Journal of Climate*, 26, 9477-9506

Lwasa, S. 2010. Adapting urban areas in Africa to climate change: the case of Kampala. *Current opinion in environmental sustainability*, 2: 166-171.

McSweeny, C., New, M., Lizcano, G. 2010. UNDP Climate Change Country Profiles:

Uganda. Available at: http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/index.html?country=Uganda&d1=Observed&d2=Extremes&d3=Timeseries.

Ministry of Energy and Mineral Development (MEMD), 2016. Energy Performance Report for Uganda. MEMD, Kampala Uganda.

Ministry of Health, 2017. Annual Health Sector Performance Report 2016/2017. Ministry of Health. Kampala Uganda.

Ministry of Lands, Housing and Urban Development (MoLHUD). 2017). Uganda Support to Municipal Infrastracture Development (USMID) Programme. Summary Status Report to MPs and Stakeholders, February 10, 2017

Ministry of Local Government, 2010. Urban situational analysis in Uganda. National Urban Development Policy support. Kampala Uganda.

Ministry of Water and Environment, **2009.** Vulnerability Assessment of Ugandan Water Resources to Climate Change. MWE. Kampala Uganda.

Ministry of Water and Environment, 2012.Wetland Management. MWE. Kampala Uganda.

Ministry of Water and Environment, 2013. The National Forest Plan 2011/2012 – 2021/2022. MWE. Kampala Uganda.

Ministry of Water and Environment, 2015a. Economic Assessment of the impacts of climate change in Uganda. MWE, Kampala Uganda.

Ministry of Water and Environment, 2015b. Uganda Wetlands Atlas – Volume 1: Kampala City, Mukono and Wakiso Districts. MWE. Kampala Uganda.

Ministry of Works and Transport. 2012. The Climate Risk Management Strategy for the transport sector. MoWT. Kampala Uganda.

Namaalwa, S., Funk, A., Ajie, G. S., & Kaggwa, R. C. (2013). A characterization of the drivers, pressures, ecosystem functions and services of Namatala wetland, Uganda. *Environmental Science & Policy*, *34*, 44-57.

National Environment Management Authority (NEMA). 2009. Uganda: Atlas of our changing environment. NEMA. Kampala, Uganda.

National Environment Management Authority (NEMA). 2010. State of the Environment Report for Uganda, 2010. NEMA. Kampala, Uganda.

National Forestry Authority (NFA). 2009. National Biomass Study: Technical Report. NFA, Kampala Uganda.

Northrop, E., Biru,H., Lima, S., Bouye M., & Song, R. 2016. Examining the alignment between the Intended Nationally Determined Contributions and Sustainable Development Goals. Working Paper. World Resources Institute. Available at: https://www.wri.org/sites/default/files/WRI_INDCs_v5.pdf.

Stern, N. 2006. Stern Review on The Economics of Climate Change. Executive Summary. HM Treasury, London.

Taylor, P., & Peter C. 2014. Strengthening climate resilience in African cities. A framework for

working in informality. Climate and Development Knowledge Network (CDKN).

Twinomuhangi, R., Lafontaine, A., Karani, P., & Ogwang, B.H. 2012. Adaptation to Climate Change. Background paper to the Development of the National Climate Change Policy and Implementation Strategy for Uganda. Ministry of water and Environment. Kampala Uganda.

Twinomuhangi, R., Richens, P., Sserunkuma, D., Mpairwe, D., Byakagaba, P., Kahubire, E., & Kasaija P., 2015. The Uganda Sustainable Development Report – Strategies for sustainable land management, Final Draft Report. United Nations Development Programme & Ministry of Finance Planning and Economic Development. Kampala Uganda.

Twinomuhangi, R. & Monkhouse C. 2015. Economic assessment of the impacts of climate change in Uganda: Key results. Climate and Development Knowledge Network.

United Nations, 2015a. The Millennium Development Goals Report

United Nations, 2015b. Transforming the World: The 2030 Agenda for Sustainable Development. Available at: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

Uganda Bureau of Statistics (UBOS). 2015. The 2015 Annual Statistical Abstract. UBOS. Kampala Uganda

Uganda Bureau of Statistics (UBOS), 2017. Uganda National Household Survey 2016/2017. UBOS. Kampala Uganda.

UN Habitat, 2009. Climate Change Assessment for Kampala, Uganda: a summary. Cities and Climate Change Initiative, UN Habitat

UN-Habitat, (2012). Uganda National Urban Profile. United Nations Human Settlements Programme. Nairobi Kenya.

UN-Habitat. 2013. Flood risk assessment, strategies and actions for improving flood risk management in Kampala. Kampala, Uganda.

UN-Habitat, (2016a). Towards achieving SDG 11 in Uganda: Making Cities and Human Settlements

UN-Habitat, 2016b. World Cities Report 2016: Urbanisation and Development – Emerging Issues. United Nations Human Settlements Programme (UN-Habitat).

USAID., 2014. An overview of climate change and heath in Uganda. USAID.

Vermeiren, K., Adyia, B., Loopmans, M., Tumwine, F.R., & Rompaey A. 2013. Will urban farming survive the growth of African cities? A case-study in Kampala, Uganda, *Land Use Policy*, 35: 40–49. http://www.sciencedirect.com/science/article/pii/S0264837713000756#. Accessed on 2nd October 2017.

Willows, R.I. and Connell, R.K. (Eds.). 2003. Climate adaptation: Risk, uncertainty and decision-making. UKCIP Technical Report. UKCIP, Oxford.

World Bank, 2011a. Guide to climate change adaptation actions in cities. World Bank Group.

World Bank, 2011b. Africa's water resources in a changing climate: towards an operational perspective. A summary report. Available at: http://documents.worldbank.org/curated/en/731511467990383417/pdf/699630ESW0P1080Climate0Final0Report.pdf

World Bank, 2012. Adaptation to Climate Change. Assessing the World Bank Group experiences, Phase III. Independent Evaluation Group. Available at: http://lnweb90.worldbank.org/OED/OEDDocLib.nsf/DocUNIDViewForJavaSearch/AE2609757A3049E985257AA3006E11A8/$file/cc3_full_eval.pdf

World Bank. 2015a. Uganda climate profile. World Bank, May 1 2015.

World Bank. 2015b. Promoting Green Urban Development in African Cities, Kampala Uganda.

World Bank Group, 2015. Uganda: Strategic Climate Diagnostic. World Bank Group.

World Health Organisation (WHO). 2015. Health and the Environment: Addressing the health impact of air pollution. http://apps.who.int/gb/ebwha/pdf_files/WHA68/A68_ACONF2Rev1-en.pdf . Accessed on 4th October 2017.

7. ANNEXES

7.1 Annex 1: Concept Note: Programme for building urban climate change resilience in Uganda

Programme background situation

Uganda is a Least Developed Country (LDC) that is predominantly rural but has a high urbanization rate currently at 5.2% per annum, one of the highest in the world. The 2014 Uganda Population and Housing Census suggest that 21% of Uganda's population lives in urban areas compared to 10% in 1991. The country's urban population could be 30% by 2035, and 50% within the next 50 years. The country is grappling with the rapid urbanization challenges that include among others: growth of informal settlements and slums, poor state of infrastructure (housing, transport, energy supply, water supply, sanitation etc.) degradation of ecosystems and natural assets, poor air quality, solid waste management, urban poverty, gender inequalities, as well as weak physical planning and urban governance challenges.

Like the rest of the country, urban areas are already suffering from the impacts of climate change, more especially extreme temperatures, extreme rainfall, floods and droughts. Recorded temperature has increased by1.5^{0}C the last 50 years. Although the precipitation levels have not changed significantly, the patterns have become more erratic. Future climate change will further worsen the vulnerability of urban systems to climate change and undermine achievement of sustainable urban development in Uganda. The urban areas will have increased construction and reduction of green spaces, which will increase the temperature further (urban heat island effect). The increased constructions will also increase surface water run-off from climate change if no action is taken. The greater concentration of people and assets in urban areas means that the impact of natural disasters and a changing climate can be devastating, both in terms of human lives lost and economic livelihoods destroyed. The poorer segments of the urban population are particularly vulnerable, especially those in slums, because they live in more hazardous settlements and lack the necessary safety nets to recover from economic, environmental and climatic shocks. A recent study profiling urban climate change finds that the dimensions of urban vulnerabilities extends not only to housing and the built up environment but to other sectors: energy supply, transport and mobility, water supply and sanitation, urban economy (tourism, trade and industry), ecosystems and natural resources, urban agriculture and food security, and lack of reliable climate information and early warnings. A recent economic assessment of the impacts of climate change in Uganda found that both residential and public buildings are highly exposed to climate risk. The costs arising from loss of resilience in residential buildings to the effects of climate change in Uganda is estimated to reach USD 60-76 million in 2025, rising to USD 347-621 million in 2050. Although adaptation is the priority for Uganda, the carbon-intensity of future economic growth is also a matter of concern.

Failing to address climate change in urban areas is already placing economic activity and the millions of lives and livelihoods at risk. It is also important to recognize the linkages between functional ecosystems and water security, food security, and disaster risk reduction. Securing resilience for urban populations is not only a climate change issue, but is also developmental issues, as well as equity and justice issue. It is the poorest people, and women in particular, in the urban areas who are the most directly affected. And where low-income urban dwellers are pushed to the physical margins of the city (drained wetlands) they may become even more vulnerable to extreme weather events, as well as undermine the ecosystem services that would otherwise be provided to all city dwellers

The solution: building urban resilience

The future resilience of Uganda's urban systems will largely depend on how climate and non-climate drivers are tackled together. Addressing the urban adaptation agenda will require innovative initiatives that also enhance socio-economic development and poverty reduction and are appropriately scaled to incorporate not only the urban space but also the broader surrounding biophysical landscape that, both directly and indirectly, influences the health of the urban system and the populations that live in them. Sustainable energy and mobility issues are central to the urban economy, livelihoods and the environment and should thus be an integral part of building urban resilience. Increased resilience of urban systems to climate change has the potential to contribute very significantly to overall sustainable urban development. However, increasing urban resilience will also require an ecosystem based approach to climate-induced disturbances and other pressures that requires interventions at different scales, beyond urban territorial boundaries (e.g. watershed boundaries) but also within the city (e.g. wetlands and open spaces), to embed in the national policy framework and institutional context.

Objectives of the programme

The overarching aim of the programme is to assist urban authorities to build greater resilience to climate change and disaster risks and achieve their sustainability ambitions.

The programme addresses three issues:

- The short and long-term adaptation of urban systems to the impacts of climate change impacts;
- Promoting green growth solutions that enhance low emissions development path for urban areas, and;
- Promoting sustainable development by transforming the threat of climate change into development opportunities for urban residents.

The programme prioritizes technical and institutional capacity building to address to climate change; building resilient urban ecosystems to deliver essential ecosystem services to urban populations; protect urban areas from natural/climate hazards (floods); increased access to green energy solutions to increase energy security and reduce GhG emissions, promote climate smart urban and peri-urban agriculture systems to enhance food self sufficiency and improve livelihoods, enhance water security in a changing climate. The programme will foster investment in city level planning, green infrastructure and building codes, and will promote ecosystems based adaptation as a cost-effective and inclusive climate adaptation strategy.

Given the complexity of issues to address, urban resilience measures will be completed by complementary solutions to secure the overall cost-effectiveness of the programme. Intervention at national scale will be a prerequisite in order to frame the most relevant and efficient ways for local intervention, while ensuring overall consistency of the operations and enabling the up-scaling of the project's results. The approach will also engage urban authorities in long-term collaborative partnerships to identify areas of need and opportunity, as well as to define robust responses toward building resilience.

Programme components

1. ***Technical and institutional capacity enhancement (national scale and city scale)***

At the national level, the programme will involve, adjusting/climate proofing physical planning and urban development planning processes, identifying key national level adaptation activities to build on; revise building design codes and standards to promote eco-building and eco-cities, and pursue opportunities for mainstreaming sustainable energy and climate change resilience in key sectoral planning processes.

At the urban areas scale, the programme will involve in:

- Raise climate change awareness among urban authorities' policy and decision makers and the wider public
- Training key technical staff of urban authorities in urban climate risk management and climate resilient development.
- Development of stand-alone climate change strategies/action plans for selected municipalities. The action plans should as of necessity have a component of sustainable energy/green energy.
- Put in place an institutional structure/unit at the urban authorities to coordinate climate change action.
- Mainstream climate change in Municipal/Urban development plans and strategies

2. ***Urban ecosystem management/restoration (national and city scale)***

At the national level the programme will involve identification of critical ecosystems that cut across urban/district authorities that need to be restored or managed and mobilizing the different actors to engage in restoration and management of the ecosystems.

At the urban areas scale, the programme will involve in:

- Community mobilization and sensitization on the need for ecosystem restoration and conservation
- Identification of preferred ecosystem restoration sites for ecosystems inside the urban territory (green spaces), passing through the urban territory (rivers) and ecosystems surrounding the urban areas (watersheds, forest and other productive landscapes). The location of the programme's ecosystem based adaptation interventions will be carefully selected to maximize the return on investment.
- Initiate urban ecosystem restoration activities. These can be collaboratively done between national and urban institutions, and engaging local communities. The restoration of the degraded ecosystems needs to be carefully tailored – based on rigorous scientific research – to manage the expected climate change conditions e.g. depending on the needs - plant species that are resilient to droughts, extreme temperatures, and/or effective at binding soils during extreme rain events/floods are necessary.
- Implement processes to ensure their completion, the functioning and the maintenance of the initiatives, taking into account potential disturbances: define prevention, information (e.g. early warning) and recovery processes.
- Initiative livelihood diversification programmes for vulnerable groups (urban poor, women, youth etc.) in order to incentivize ecosystem protection, and also to ensure that they do not encroach on protected/restored ecosystems.

3. ***Urban sustainable/green energy solutions***

Energy needs affect all urban sectors and as demand increases this will be the major player in the urban systems' efficiency and use of renewables. Uganda's urban areas are currently facing energy security challenges: load shading and power cuts, high electricity tariffs, use of traditional biomass for cooking, less use of clean energy. Energy is also responsible for increasing GhG emissions and the deteriorating air quality. Urban growth and development will need to adopt renewable energies to meet the demands and green energy incentives need to be developed to promote green investment. Urban authorities should aim at having 10-20% of energy demand being met from local production (within the urban territory).

Programme support under this component will be focus on:

- Mobilization and sensitization of communities, institutions, and private sectors on energy efficiency and eco-friendly energy solutions
- Up-scaling the use of improved cook stoves (eco-cook stoves) to institutions and households i.e. 100% coverage in institutions and 30-40% coverage in urban and peri-urban households
- Introduce and roll out alternative cooking fuels e.g. briquettes, biogas,
- Investing in solar energy installation for municipal authority offices, markets, institutional buildings, street lighting, and for water pumping; and encouraging households to install solar lighting and solar water heating.
- Incentivising the private sector (banks and microfinance, telephone companies, manufacturers, traders, informal sector) and community groups to engage in the production, trade, maintenance and financing of eco-friendly energy solutions.

4. ***Urban water harvesting and conservation:***

- Support water harvesting and storage in urban institutions: municipal offices, schools, health facilities and other public buildings
- Support households to engage in water harvesting and water storage
- Increase water retention at plot level; embedding water harvesting and water efficiency in building codes and standards. For example aiming at 50% of newly approved buildings should have water harvesting units/systems installed

5. ***Sustainable entrepreneurial urban and peri-urban agriculture***

- Explore opportunities for eco-friendly/climate smart urban and peri-urban agriculture
- Set up UPA resource/demonstration centres for training; some schools that have land can be used as training/demonstration centres
- Support institutions, community groups, youth groups to engage in entrepreneurial climate smart UPA
- Integrate UPA with green energy and water management solutions – biogas, composting, and rain harvesting/irrigation, solar driers/pumps i.e. self-sufficient farming projects.
- Support urban based fish farming and aquaculture
- Engaging the youth in UPA
- GKMA and all emerging cities and municipalities

6. ***Sustainable Financing Schemes***

At the national scale, analyse private sector barriers for investment in urban climate resilience activities (how to make climate change projects "bankable"), analyse insurance opportunities for urban adaptation infrastructure

At the city scale the programme will engage in:

- Design new income generating adaptation/mitigation models
- Support urban authorities' creditworthiness scheme if relevant/appropriate
- Assess interest from insurance firms, tax incentive schemes, and other city financing options (e.g. local financing facilities) to provide sustained finance for urban adaptation/mitigation adaptation activities
- Train urban authorities in developing bankable projects/project development

7. ***Knowledge management***

- Involvement of central government, urban authorities, communities and key stakeholders at all stages, combining horizontal (bottom-up and top-down) and vertical flows of information
- Establish a framework for up scaling urban climate change resilience within the whole country
- Establish a research framework – partnership with universities and research organization to foster innovations.
- Communicate the project approach among urban areas and engage urban authorities' leaders in regional and global discourse to bridge knowledge gaps on urban resilience and green cities
- Building of a strong evidence base on the need for increased urban resilience as a contributor to sustainable urban development.

Project implementation arrangements

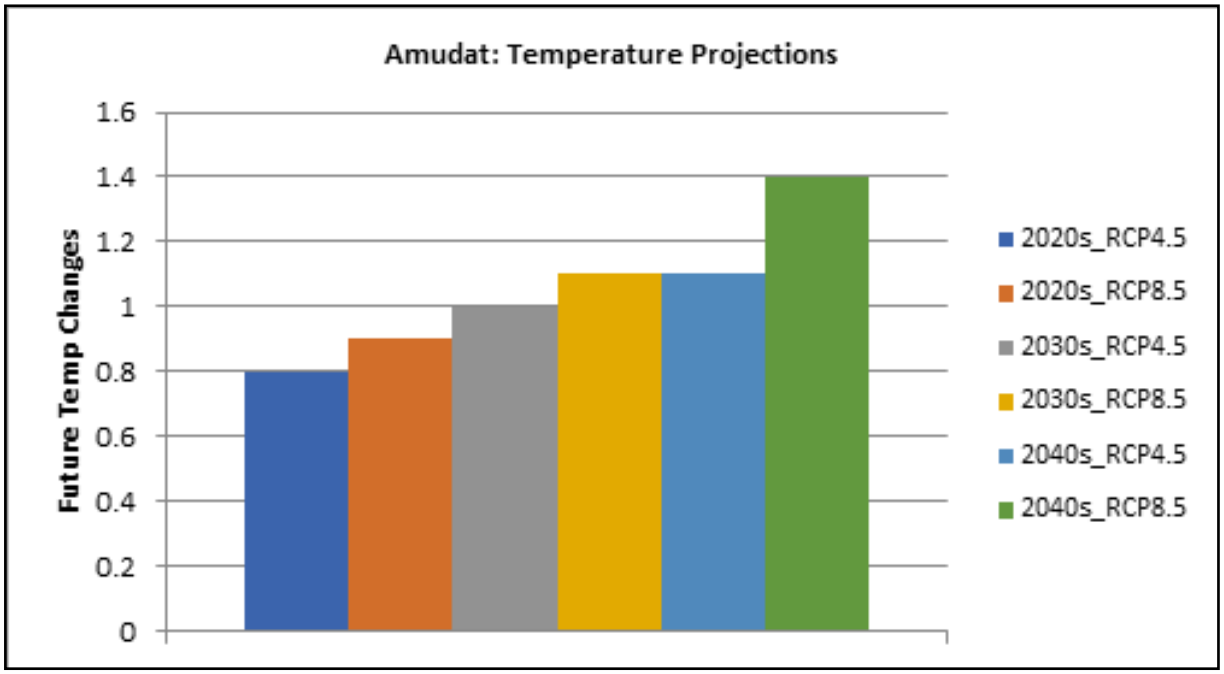
The programme cost is estimated at USD 15 million. The Ministry of Lands, Housing and Urban Development (MoLHUD) will be the lead project implementation agency supported by the Ministry of Water and Environment (MWE) - Climate Change Department (CCD) and the municipal/urban authorities. The other project partners include: Ministry of Energy and Mineral Development (MEMD); Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), Ministry of Finance Planning and Economic Development (MoFPED); National Environment Management Authority (NEMA); National Water and Sewerage Corporation (NWSC), and Makerere University Centre for Climate Change Research and Innovations (MUCCRI). Table 1 below summaries the project components, budget and responsibility for implementation.

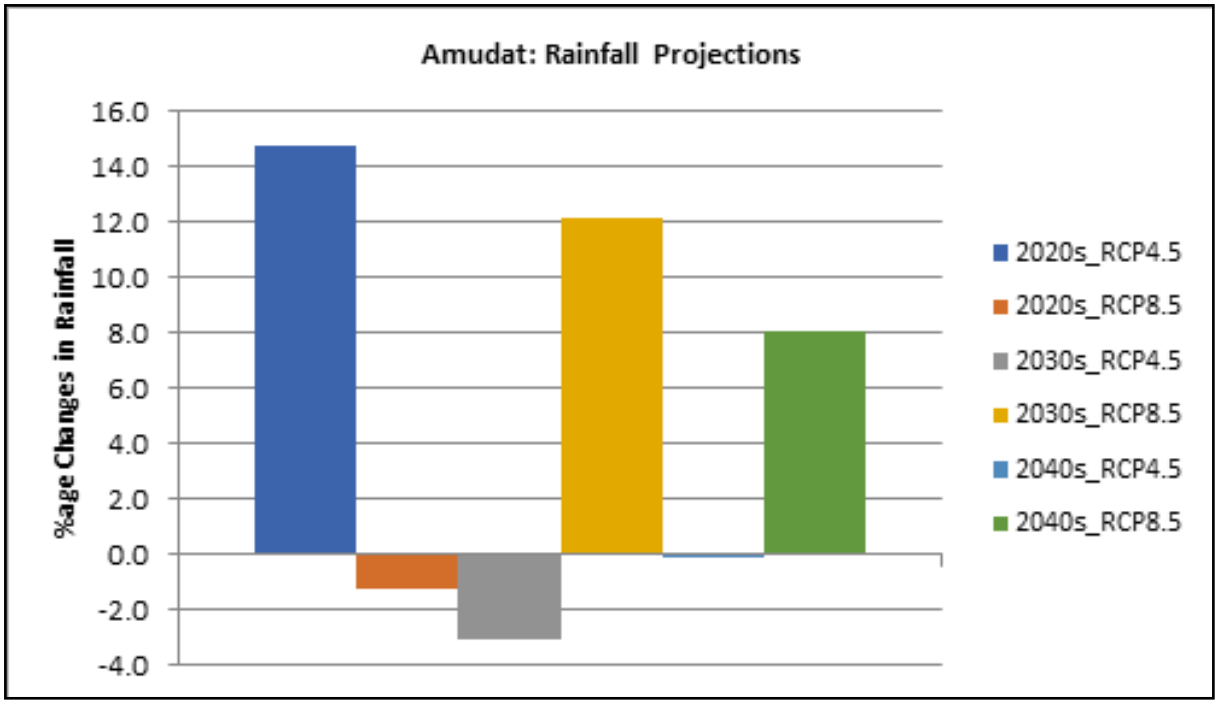
Table 1: Programme summary

Project component	Estimated Cost (USD)	Responsibility
1. Technical and institutional capacity enhancement	1,100,000	Ministry of Lands, Housing and Urban Development; Ministry of Water and Environment; Urban/District authorities, MUCCRI, Development Partners
2. Ecosystem restoration and management	4,000,000	Ministry of Lands, Housing and Urban Development; Ministry of Water and Environment; National Environment Management Authority; Urban/District authorities, Development Partners, NGOs, community groups
3. Urban sustainable/green energy solutions	2,400,000	Ministry of Lands, Housing and Urban Development; Ministry of Energy and Mineral Development, Urban/ District authorities, Development Partners, Private Sector, NGOs and community groups
4. Urban water harvesting and conservation:	2,100,000	Ministry of Lands, Housing and Urban Development; Ministry of Water and Environment; National Water and Sewerage Urban/District authorities, Development Partners, Private sector, NGOs, community groups
5. Sustainable entrepreneurial urban and peri-urban agriculture	1,800,000	Ministry of Lands, Housing and Urban Development; Ministry of Agriculture, Animal Industry and Fisheries, NARO, Development Partners, Private sector, NGOs, community groups
6. Sustainable Financing Schemes	500,000	Ministry of Lands, Housing and Urban Development; Ministry of Finance, Planning and Economic Development, Urban/District Authorities, Development Partners, Private sector and NGOs.
7. Knowledge management	1,200,000	Ministry of Lands, Housing and Urban Development; CCD - MWE, MUCCRI, Urban/District Authorities, and Development Partners
Programme management (15%)	1,965,000	Ministry of lands Housing and Urban Development
Estimated programme cost	15,065,000	

7.2 Annex 2: Climate change profiles for individual urban centres

7.2.1 Amudat Town Council



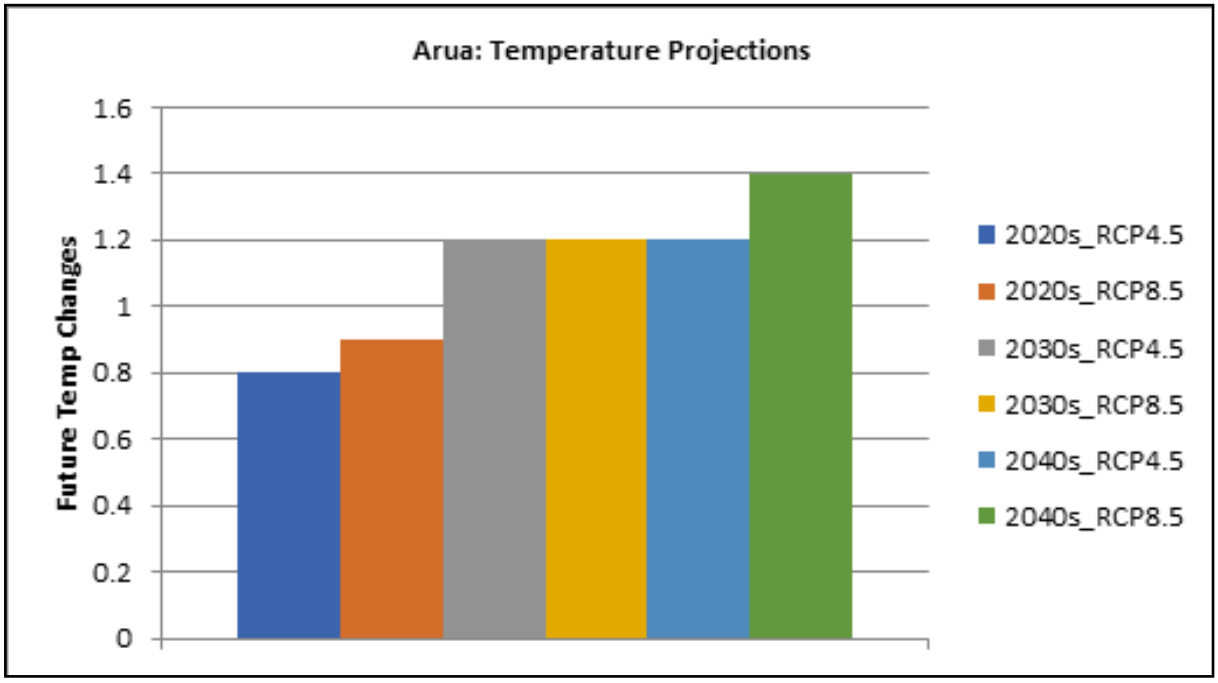


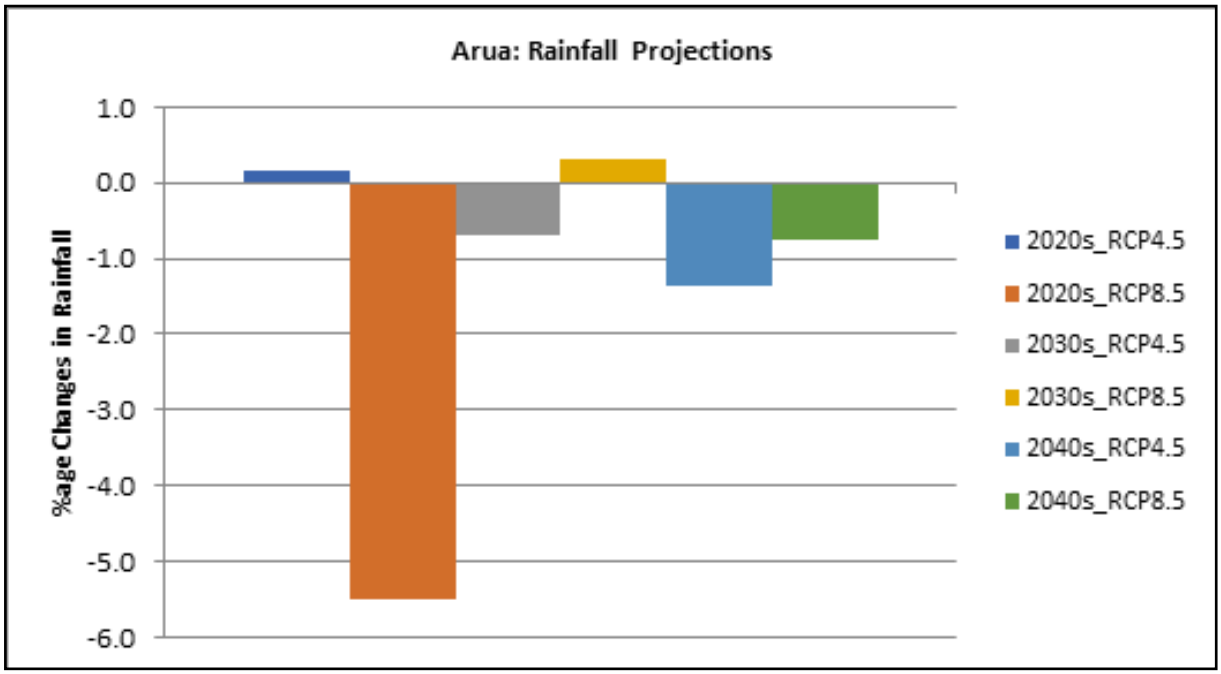
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 22.8^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.1^{o}C under RCP 4.5 and by 1.4^{o}C under RCP 8.5 scenario.
Rainfall – observed trends (1975 – 2005)	• Annual mean 1167mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -0.1% under RCP 4.5 scenario and +8.1% under RCP 8.5 scenario
Extreme weather events	• Long droughts especially in the last three years, 6 months of no rain • Erratic rainfall with storm winds, • Flooding affects the whole TC: destruction of crops, relocation of people and loss of livestock • River Kanyangarengin burst its banks causing property destruction • Flooding occurs even when it has not rained in the TC i.e. rains in the surrounding sub-counties like Loro cause flooding in the TC.
Exposure to other hazards	• Storms winds
2. Infrastructure	
Water supply	• Access to safe water supply - 42.3% • Boreholes are the main water source (39.7%); drying of bore holes and during prolonged drought • No piped water (0%) but MWE has started water supply in the TC • Protected springs 0.5% • Rivers are used by some households – shared with animals • Valley tanks for animals – also used by some households, drying of valley dams during prolonged drought • Contamination of water sources by animals and flooding
Energy	• Electricity coverage is small - only the main roads i.e. Kitale and Moroto roads • Extension of hydroelectric power (national grid from Jinja to Amudat from Muyembe) is on going. • Electricity is exclusively used for lighting purpose • Most households use kerosene for lighting • Some shops use solar energy for lighting • Firewood/dead wood is mostly used for cooking • Charcoal is also used by a big percentage of households - increased cutting of trees • Very few use LPG or biogas
Sanitation and sewerage	• Sanitation is a very big challenge. • Pit latrine coverage is low (0.8%) • 99.2% do not have any sanitation means/pit latrine • Open defecation is a common practice – attributable to the cultural norms • Loren, Silent Night and DNDI guest houses have septic tanks • Diarrhoea, cholera and typhoid, eye infections and skin diseases are common
Solid waste management	• Solid waste generation is very low - – small population • Wheelbarrows used to transport waste to burning site • Backyards used to dispose uncollected waste

Storm water drainage	• Drainage is a big problem in the TC • Runoff and floods from upstream damages roads and makes them impassable
Transport	• 20 roads under the mandate of the TC, however most are not open yet • Unpaved roads, very poor and impassable roads in rainy season
	• Ministry of Works funded the tarmacking of 1km KK road – the only tarmac road and is yet to be completed • Boda boda is the only means of public transport
Housing	• Mostly semi-permanent mud and wattle houses- attributable to being pastoralist community
3. Governance	
Planning	• 5-year Development Plan 2015/16 – 2019/20, does not mention climate change. • No Strategic Plan • No Structure Plan/Physical Development Plan
Financing	• Budget is silent about climate change • Under NUSAFIII, tree planting along the watershed areas is catered for
Participation	Participation of citizens in planning
Administrative units assigned to address climate change and disaster risk management	• No structure to address climate change • MWE started water supply in the town council and Amudat Sub County. • OPM and MWE, ZOA and C&D constructed Valley tanks • ZOA support resettlement programs, education- community schools, early childhood development, functional adult literacy centres, farmers in honey production, water for production valley dams - simple irrigation to enable communities grow vegetables throughout the year. • Introduced banana along the river banks to hold soil • Established agro-farms school approach in collaboration with FAO • Under UNDP consortium - C&D and ACTED took the community through D&R process and come up with action plans on climate change • C&D: engages in training for crop production e.g. greens, alternative energy like briquettes and boreholes • ACTED: Has monthly bulletin and provides warning system for the farmers on rainfall, seasons and other information engagement of department leaders • Others include: Pokot Zonal Integrated Development Project, Association for World Education, WFP, UNICEF, Happy cow and Vision Care
Willingness of urban authorities (leadership) to address climate change	• NUSAFIII, tree planting was done along the watershed areas
4 Socio-economic characteristics	
Population/demographics	• TC covers 15 sq. Km • Population projected at 10,530 (District Planning Unit) • Total fertility rate 7.9 • Annual population growth rate 5.9% compared with 3.3 national • Households 2,877 • Sex distribution 5,977 male and 4,533 female • Population density is very low 58.5 persons per sk.km compared to 123.9 national

Urban poverty	• High poverty levels • Majority derive livelihoods from livestock and maize produce • Semi nomadic life style due to dry spells and lack of adequate water • Majority live in poor housing and on little income with majority having no formal employment
Percentage of urban areas susceptible to climate hazards	• Floods affect the entire TC
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Many rivers and streams exist • Encroachment and pollution destroying biodiversity • Charcoal burning, poaching and bush burning for grazing cattle is another challenge • Mining (gold and sand), stone query and bricklaying degrade the environment
Natural assets	• Increasing cutting of trees for charcoal affects TC and beyond • Pian-Upe game reserve is currently receiving an increasing number of tourists, both foreign and national • Deposits of limestone, marble, gold, iron ore, diamond, gems and rubies that can be commercially exploited – 1994 survey by Korean firm • Rivers and streams • Gold, marble and sand
Climate change response priorities	• Enhance water security and water resource management • Energy access and energy security • Improved sanitation • Flood management - improved drainage in the TC • Resilient transport infrastructure

7.2.2 Arua Municipality





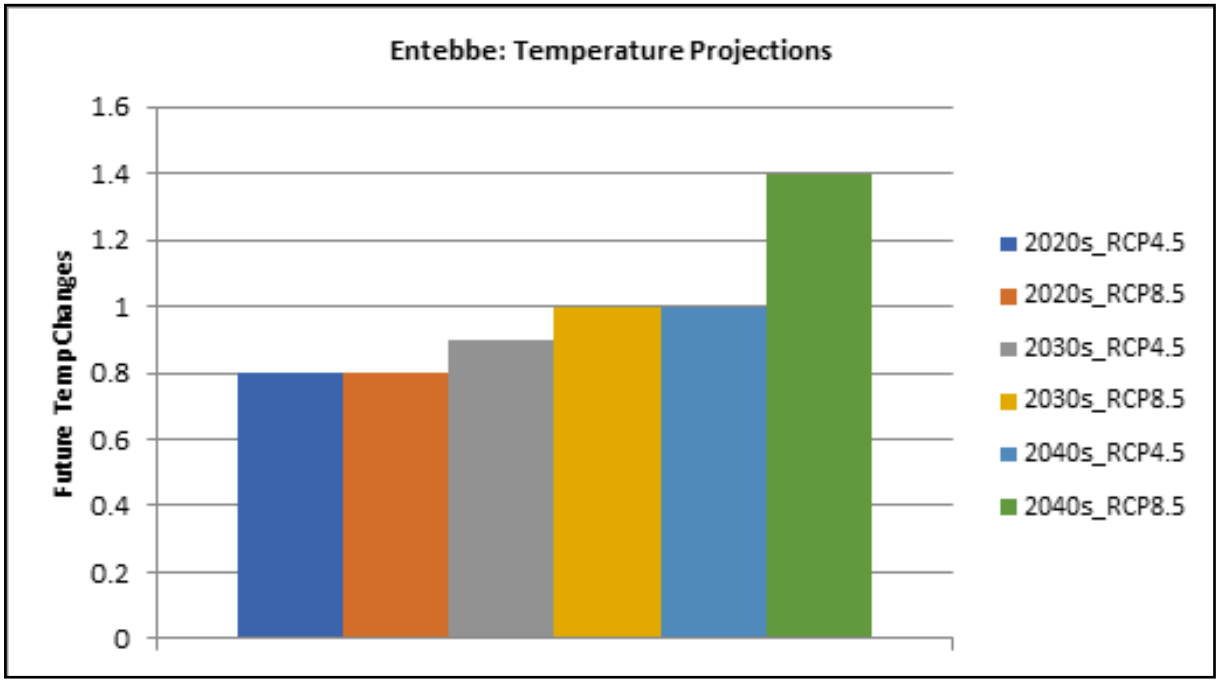
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 22.8^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.2^{o}C under RCP 4.5 scenario, and 1.4^{o}C under RCP 8.5 scenario.
Rainfall – observed trends (1975 – 2005)	• Annual mean 1327mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -1.4% under RCP 4.5 scenario and -0.8% under RCP 8.5 scenario

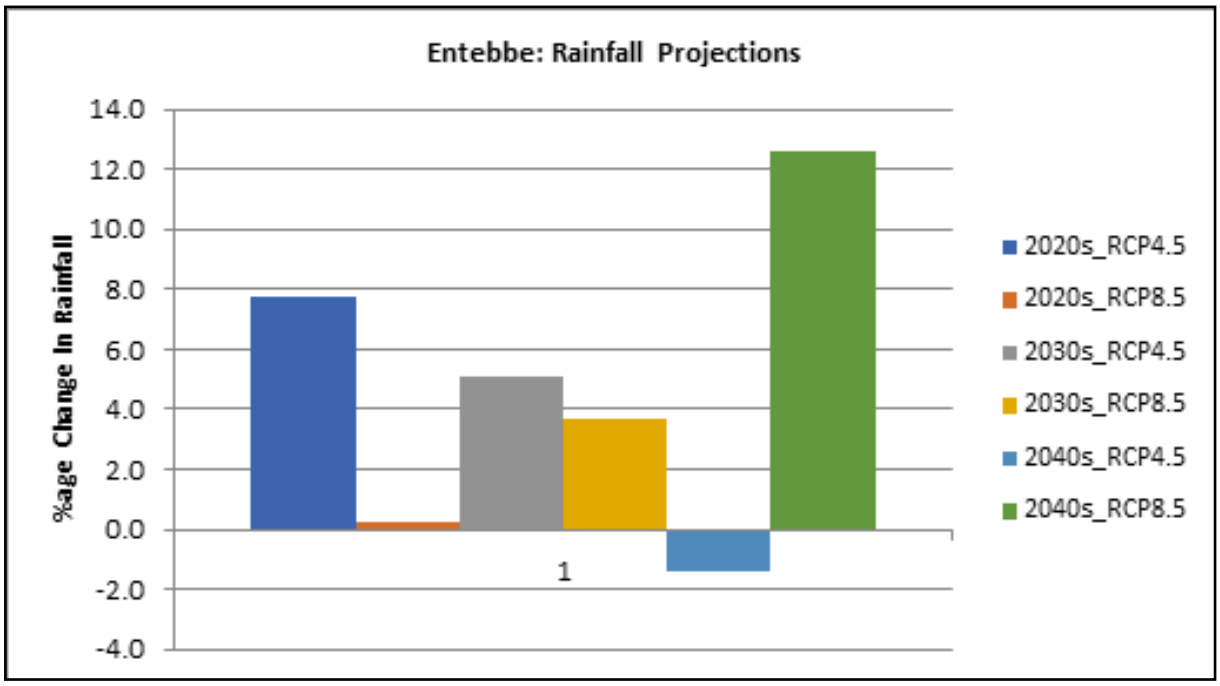
Extreme weather events	• Rainfall patterns have changed; high intensity rainfall in a short time, reduced amount of rainfall. • Increased occurrence and severity of droughts and heat waves: affecting farming, water availability and beautification programmes • Floods are the increase and becoming more intensive
Exposure to other hazards	Deforestation and land degradation, floods, and food insecurity
2. Infrastructure	
Water supply	• Access to piped water - 6,464 households (63.4%). • River Enyau is the main source of piped water, supplied by NWSC • The river dries up in dry season/droughts water scarcity • Expensive to connect to piped water supplied by NWSC, water tariffs are high – not affordable • Boreholes and protect springs supply communities with water but dry up during the dry seasons/droughts • Bore holes are used by 2,743 households (26.9%) • Floods lead to water contamination especially the springs and streams
Energy/electricity	• Electricity from Nyagak hydro power station in Nebbi district mainly for lighting. Unreliable supply especially during the day . • Nyagak generates 3.5MW, which is too small for the West Nile region, including Arua – frequent power outages and load shedding. • During dry season water in the river reduces further reducing generation at Nyagak power station. • 4,066 (39.9%) households access to electricity and 1,564 (15.3%) households used kerosene/Tadooba for lighting • Businesses rely on diesel generators; high GHG emissions and affect air quality. • Use of solar energy for lighting in households and institutions. • Under USMID project, solar powered street lighting has been installed on selected roads • High use of charcoal and firewood for cooking (deforestation). Charcoal is becoming scarce and expensive, • Low use of energy saving cook stoves. • The region supplies charcoal to Kampala city – high deforestation and degradation. • Use of LPG and biogas is very limited in the district. • NMWS uses diesel generators to pump water, no use of solar powered pumping as yet.
Sanitation and sewerage	• No central sewer system at the moment. NWSC is constructing the sewer system. • Pit latrine is comments - coverage is 75%. • Town relies on septic tanks and pit latrines • Over 25% of the households do not have latrines (5 year Development Plan); 56 households (0.5 %) were without any toilet facility (2014 census) • Sanitation coverage fluctuates with changes in weather – improves during dry season

Solid waste management	• Has a solid waste compositing facility under the CDM project – supported by World Bank through NEMA. • The compost plating is functional, but is not doing well as had been planned, some components are not working well, and funding is a problem because local revenue is inadequate. • No waste segregation at source. • Municipality has only 3 trucks to collect the waste. • Only 50% of the waste is collected; the rest open dumping and back yard pits are used. • Has a SWM strategy 2016-17 – 2020/21 developed through USMID support, but no funds to implement it. • 6,903 (67.7%) households disposed off solid waste properly 2014 census)
Storm water drainage	• Drainage is a major problem, causing flooding • A drainage master plan has been developed under USMID
Transport	• Both paved and unpaved roads • USMID project on paving roads and construction of drainage to manage floods
Housing	• 8,793 (86.2%) households live in dwelling units constructed using permanent roof materials, 7,760 (76.1%), permanent wall materials and 7,128 (69.9%) permanent floor materials • 2,644 (25.9%) live in semi-permanent dwelling units while 1,019 (10.0%) in temporary dwelling units • Households 8,951 (87.7%) households did not live in decent housing (2014 census)
3. Governance	
Planning	• 5-year Development Plan 20115/16 – 2019/20 • Waste Management Plan in place • Part of the USMID project • Part of the CDM Composting project. • Plan for an ecological city (Nile eco-city)- expand city from 10sq.km to 400sq.km. • Draft physical development plan is in place
Financing	• No standalone climate change strategy/plan • Attempts to integrate climate change in projects and programmes/screening of projects
4. Socio-economic characteristics	
Population/demographics	• 61,962 people (29,716 male and 32,246), • 54.5% children below 18 years, • Average annual population growth rate, 5.6%, • Population structure is expected to be youthful for the next 15 years - high dependency ratio
Population density	• No data
Urban poverty	• In 2014, 3,438 (21.3%) youths (18-30 years) were neither working nor in school (2014 census) • About 60% of the households in Municipality depend mainly on subsistence farming as their main economic activity- livestock keepers and crop farming • Only 25.7% of the population was dependent on earned incomes and 15% on property income (5 year Development Plan)

	• Agriculture has been hit hard by prolonged drought and high rate of exportation of food items to Sudan and Congo – threatening food security • Failure of agriculture due to drought and floods with their associated side effects of famine and diseases area danger • Causes of poverty in the household include drought, flood, and hail storms, pest and diseases and high post-harvest loses
Percentage of urban areas susceptible to climate hazards	• Rampant food insecurity and low household incomes among the slum dwellers (5 year Development Plan)
Per Capita GDP	• No data
5. Environment and ecosystems	
Ecosystems	• Influx of refugees from South Soudan is affecting the environment in Arua District in general, this also affects the Municipality • The natural environment is severely degraded – especially deforestation • Tobacco growing within the district puts severe pressure on land • Draining/encroachment on wetlands, green belts and open spaces, also worsens the flooding problem • Storm water is a problem, no infiltration of water. • Watersheds are not well managed, degraded. • MWE has demarcated wetlands but encroachers still occupy them, not yet restored. • Lack of institutions for environment management due to funding challenges: e.g. environmental committees are not in place. • Tree planting and beautification efforts are not enough.
Natural assets	• Plan to degazette Barifa CFR to expand Arua city. Alterative land for swapping with NFA is already acquired. Both NFA and NEMA have agreed and only waiting Parliament approval.
Climate change responses priorities	• Water security, water harvesting, water resource management • Energy security and access – mainly renewables; energy alternatives for cooking like biogas, LPG, energy efficient cook stoves • Ecosystem restoration and ecosystem management • Control deforestation and charcoal burning • Urban agriculture that is climate resilient. • Storm water management to control floods

7.2.3 Entebbe Municipality





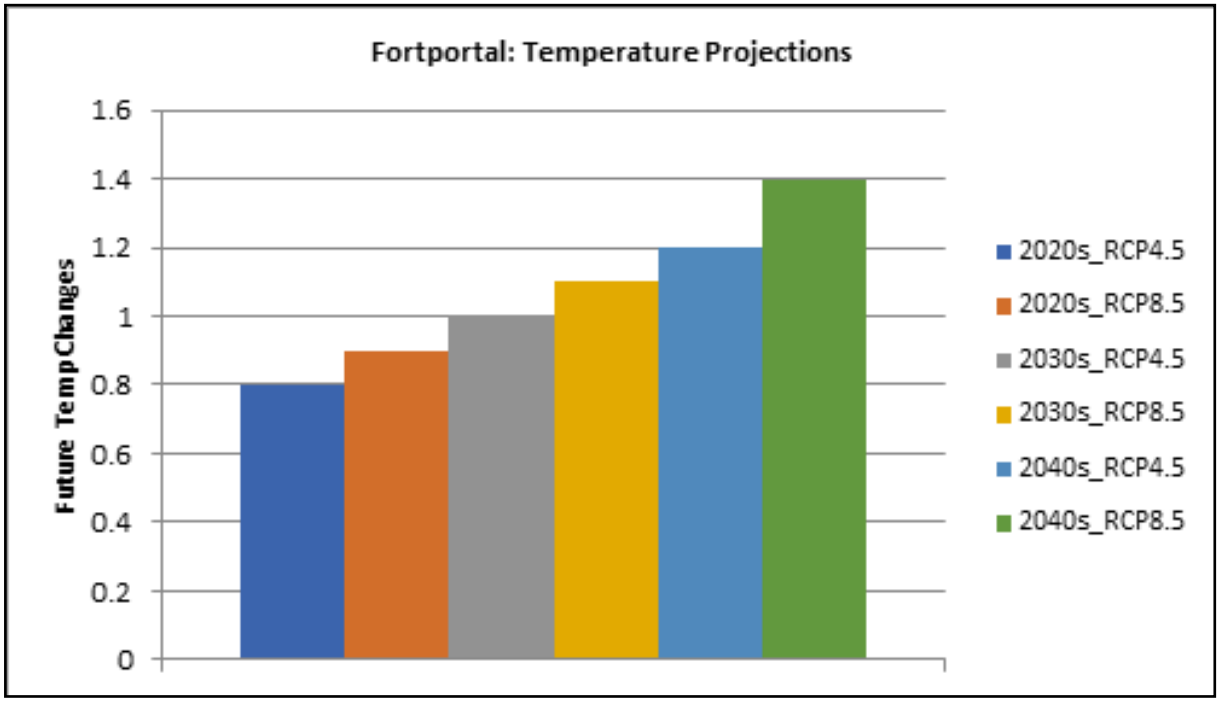
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 21.5^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1^{o}C under RCP 4.5 scenario and 1.4^{o}C under RCP 8.5 scenario.
Rainfall – observed trends (1975 – 2005)	• Annual mean 1605mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -1.4% under RCP 4.5 scenario and +12.6% under RCP 8.5 scenario

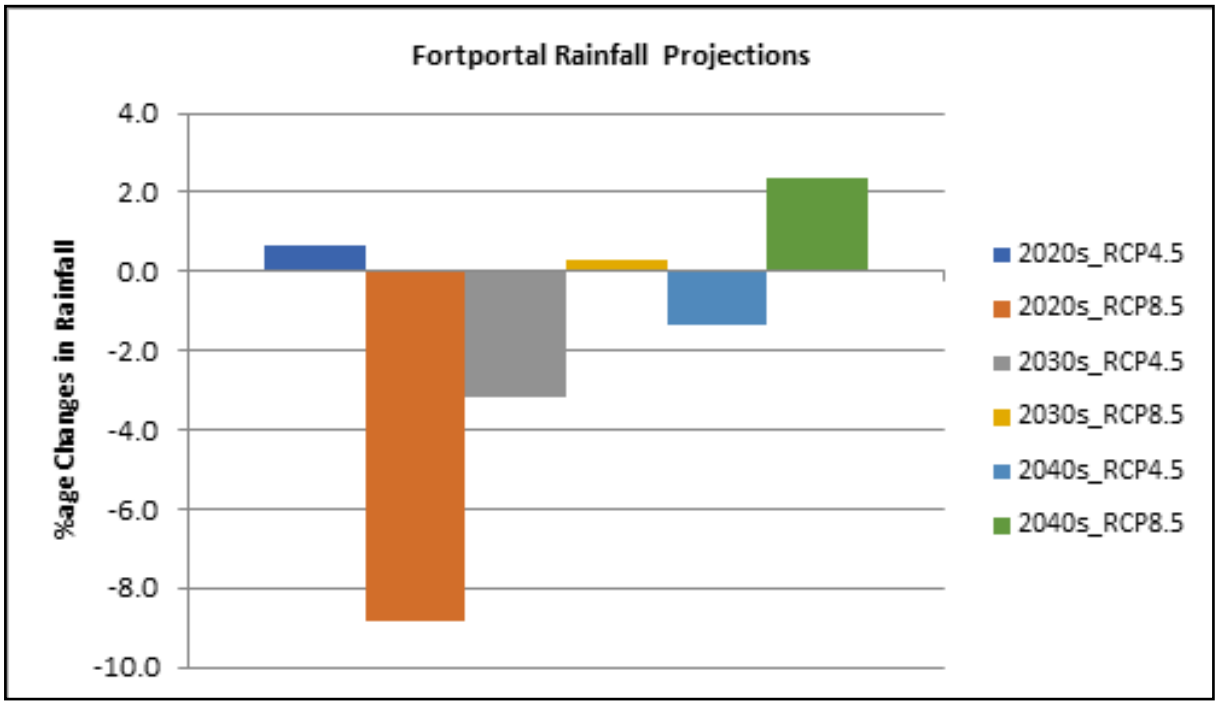
Extreme weather events	• Droughts and heat waves - low agricultural production, food shortage and high food prices • Heavy intensity rainfall, storms, unreliable rainfall • Flooding mainly in Kitubula and Abaitaababiri • Heat waves, increasing temperature up to 33^{0}C during dry season
Exposure to other hazards	• High land/ecosystem degradation
2. Infrastructure	
Water supply	• Piped water by NWSC – 85.3% coverage (2014 census), availability is largely reliable • Water drawn from Lake Victoria • Boreholes provide water to 408 (2.3%) households (2014 census) • 15% particularly from the islands and informal settlements draw water directly from Lake Victoria or use springs • Rainwater harvesting is on a small scale and is particularly practiced by those who are not connected to NWSC
Energy/electricity	• Electricity coverage - 90% of the municipality; it is reliable and is mainly used for lighting • 976 (5.5%) households used kerosene/tadooba for lighting • Areas in Kigungu and Musoli lack electricity • Charcoal (and to some extent LPG) is largely used for cooking by the households, schools and institutions • A few well off households mainly international employees afford to use electricity and gas for cooking • The use of solar energy in the municipality is limited only to street lighting
Sanitation and sewerage	• Use of pit latrines (55%), VIP latrines (30%), flush toilet (10%), • 5% has no toilet (5 year Development Plan) • The sewer system covers 45% of the municipality • In most cases those connected to the sewer system have alternative sanitation provision like stand alone septic tanks • Schools in some cases are also not connected to the sewer system
Solid waste management	• 15,407 (86.3%) households properly dispose off solid waste (2014 Census) • Main practice: collection and disposal • Disposal site is Mpuga landfill • Collection is done by the municipal trucks from skips and private collectors in affluent neighbourhoods and hotels • Skips are not enough for the municipal population • No sorting of waste • No weighing of the waste is done • No composting is practiced in Entebbe • Solid Waste Management Strategy developed - USMID support
Storm water drainage	• Most roads do not have adequate drainage • Broken/ choked drainage channels with solid waste • Repair of drainage channels and provision of drains on all roads is a priority • Drainage master plan developed under USMID

Transport	• 140,22km of roads • Only 32km are paved, of which only 19.5km are in good condition • 64.42km of roads are gravel and in bad condition as compared to the 44.02 km in good condition • Paving 10kms of roads is a priority in the 5 year Development Plan
Housing	• Temporary walls = 2,021, permanent walls = 15,918 • Temporary roofs = 174, permanent roof = 17,765 • Permanent floor 1,334, temporary floor = 16,605 (5 year Development Plan) • 14,461 (81.0%) households were not living in decent dwellings (2014 census)
3. Governance	
Planning	• Structure Plan 2008 – 2018 – being upgraded to Physical Development Plan • Climate change consideration not a guiding principle at the time of plan preparation • 5 year Development Plan 2015/16 – 2019/20 • Municipal Development Strategy 2016-2040 – USMID support • No Environmental Action Plan • Solid Waste Management strategy in place – under USMID support
Financing	• No standalone budget for climate change • Environmental issues are considered in budgeting and sectors as a cross cutting issue. • Tree planting, waste management, wetland protection and public health are some of the environmental considerations in different sectors
Administrative units assigned to address climate change and disaster risk management	• LVRLAC is partner to over 130 local governments internationally, helps in addressing climate change • Entebbe resolved to plant 3 million trees around lake Victoria • 10,000 trees seedlings provided by China Save the Wild NGO worth over UGS 11 million. • Collaborates with NEMA and NFA to enhance conservation not only in Entebbe but also Wakiso at large, Mbarara, Masaka, Jinja and other local governments that share Lake Victoria waters including the newly added Tororo district. • Protecting wetlands and lakeshore, opening of buffer road or planting of trees particularly bamboo is encouraged • Political and technical staff have been engaged in workshops relating to climate change • Entebbe staff got training on solid waste management by the Swedish through LVRLAC and vehicle was purchased to transport garbage. • Training of communities on solid waste sorting has not taken place
4. Socio-economic characteristics	
Population/demographics	• Population 69,958, (34,633 male, 35,586 female) 0.2% growth rate, about 40 percent under 15 years – indicating high dependence ratio (2014 census)
Population density	• No data

Urban poverty/economy	• Approximately 49,000 people living live in informal settlements of distributed into 13,600 households (5 year Development Plan) • Hotels are major source of revenue for the municipality • Tourism is a big potential but is not well developed - Green tourism has not been developed as an industry in Entebbe; eco-tourisms sites are being encroached upon like wetlands and forests • Some communities engaged in fishing but fish catches/stocks are dwindling very first • Some communities are engaged in agriculture but affected by droughts
Per Capita GDP	• No data
5. Environment and ecosystems	
Ecosystems	• Pollution of Lake Victoria manifested in changing watercolour - can be attributed to industrial and hotel development on the lakeshores. • Developments are hardly 5 meters from the lakeshore • Wetland degradation - size of wetlands has reduced approximately by 40% due to encroachment particularly at the municipality periphery • Brick making and sand mining are dominant and are drivers of ecosystem degradation. • Swamp reclamation is rampant • Noise and air pollution • Un safe municipal solid waste management and disposal • Small environment budget - UGS 80,000 - constraint to environment management • Has an urban forest – the CFR managed by NFA but there are plans for degazetting it for urban expansion. • The municipality manages small woodlots
Natural assets	• Lake Victoria, wetlands, urban forests and woodlots but are being degraded.
Climate change response priorities	• Ecosystem restoration and management: wetlands, open spaces and forest. • Sustainable solid waste management, greening waste management • Affordable alternative energy for cooking; reduce charcoal consumption; energy cook stoves • Reduce sand mining and brick making: alternative building and construction technologies that are eco-friendly • Climate resilient fishing and fish farming • Climate smart urban agriculture • Eco-friendly and climate smart tourism activities – green tourism

7.2.4 Fort Portal Municipality





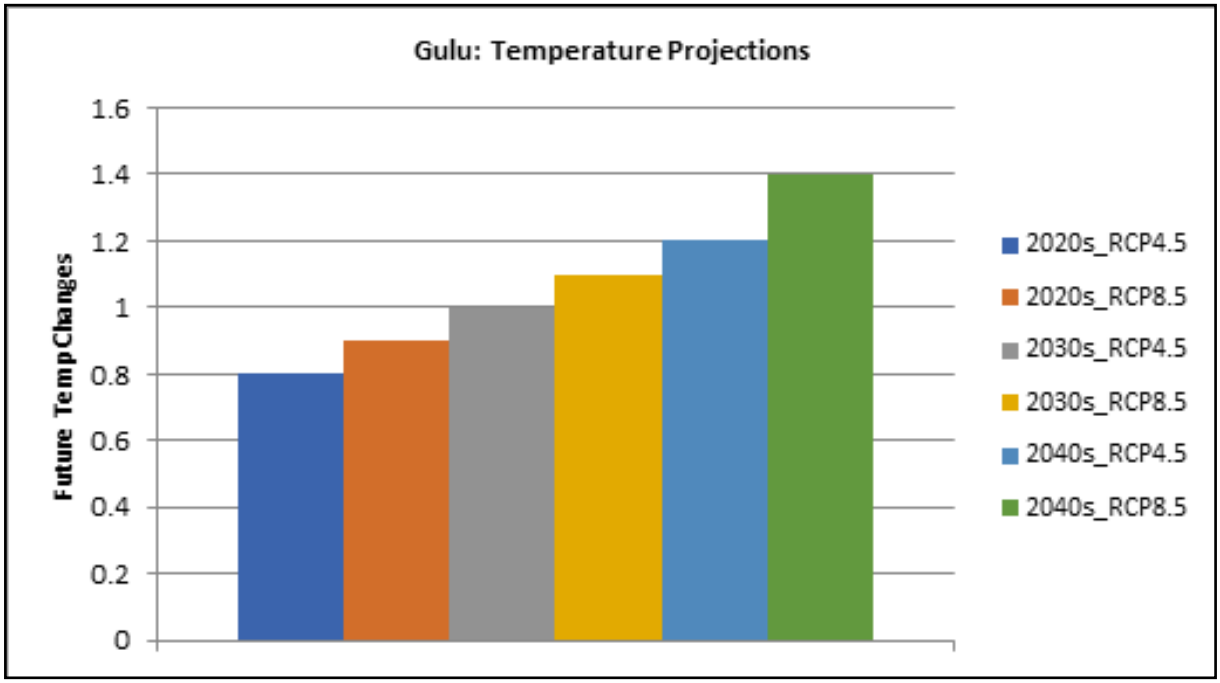
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 19.5^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.2^{o}C under RCP 4.5 scenario and 1.4^{o}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1359mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -1.3% under RCP 4.5 scenario and +2.4% under RCP 8.5 scenario

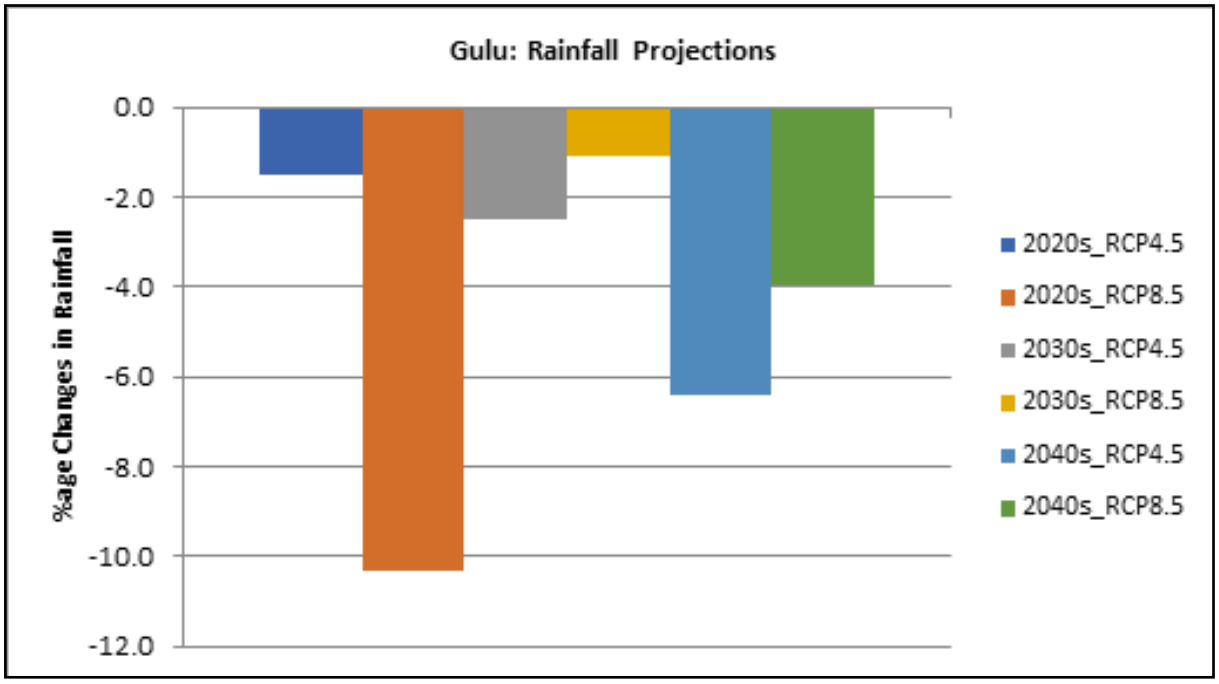
Extreme weather events	• Rising temperatures and heat waves • Unpredictable rainy seasons; erratic rains with hailstones • Drought becoming frequent – crop failures, hiking food prices and threatening food security • Reducing water levels in river Mpanga that supplies water to the town (June/July 2017) • Erratic rains with hailstones • Pests like army worm outbreak and others that affect trees and bananas
2. Infrastructure	
Water supply	• 10,846 (73.4%) of the households has access to piped water) (2014 census • 13.3% use boreholes • River Mpanga is source for piped water by NWSC. Piped water coverage is said to be over 86% • Bore holes used especially in - Bukwali, Kamengo, Kibimba and Kagote • Wells and protected springs are also sources of water • Rainwater harvesting is not a common- UNICEF is promoting rainwater harvesting in schools
Energy/electricity	• Electricity coverage is high i.e the entire Municipality is covered by network but is used mainly for lighting • 8,251 (55.8%) of the households used electricity for lighting (2014 census) • 2,888 (19.5%) use kerosene/Tadooba • Street solar lighting on some roads under USMOD programme • Some households have installed solar panels for lighting • Charcoal and firewood are widely used for cooking • Kabarole Research and Resource Centre is making efforts in promoting the use of energy saving stoves • LPG and biogas are also used for cooking by some few households
Sanitation and sewerage	• The CBD is connected to the central sewer system (NWSC) and connects to the sewerage lagoon along Kaboyo road around Muguni stream within the Municipality • 95 (0.6%) of the households have no sanitation facility (2014 census) • Septic tanks are used - cesspool emptier transport the faecal matter to the sewer lagoon • Other use pit latrines • Breakdown in the sewerage system is common • The sludge cake is used as manure • Lack of sanitary facilities in some areas neighboring River Mpanga pollutes it
Solid waste management	• Only 8,526 (57.7) households properly disposed off solid waste (Census) • Has CDM waste composting facility • Solid Waste Management Plan in pace - USMID support • Solid waste skips are placed in some strategic locations - also door to door collection method is used in some neighborhoods • Waste sorting is done at the compositing plant at Kitere • Low market for the compost - Soils are said to be fertile

Storm water drainage	• Drainage has been improved on all USMID supported roads • Drainage master plan is in place – under USMID support, however funds for its implementation have not yet been realized
Transport	• Total of 273 km of roads, most of it unpaved and vulnerable to flooding. • 0.94 km tarmac constructed under USMID support along Kagote and Nyakaana roads. • Plans are underway to tarmac 0.3 km along Rukidi III road - USMID • Under USMID, Muguni lorry park is to be tarmacked
Housing	• Low housing sector development in the Municipality • 14,718 (99.9%) of the households lived in dwelling units constructed using permanent roof materials, 62.7 % permanent walls and 69.8% permanent floor, 40.3% in semi- permanent dwellings while 0.3% lived in temporary dwelling units • 12,958 (87.7%) of the households had no decent housing (2014 census)
3. Governance	
Planning	• 5-year Development Plan 2015/16 – 2019/20 • Structure plan 2008 -2018 • Municipality to develop as Tourism City – boundary to be expanded • Developed detailed plans for Kitumba – Kabegira and Kagote –Mpanga – under USMID support • Municipal Drainage Master Plan - USMID support • Municipal Development Strategy – USMID support • Solid Waste Management Strategy – USMID support
Financing	• The budgeting is sensitive to climate change concerns. • Emphasis has been on tree planting both for beautification and conservation especially along River Mpanga. • All projects incorporate environmental issues e.g. schools upgrading and roads where trees are planted • However since local revenue is used, in most cases the funds for climate change related issues are not realized
Participation	• Toro Botanical Gardens initiative on natural resources conservation was established in 2001. Works in close partnership with NFA to conserve and restore degraded forest areas and protection of River Mpanga • JESE - natural resource management, awareness creation campaigns to create buffer zones along River Mpanga, other wetlands and protection of green open spaces • Natural Resource Defense Initiative - tree planting along River Mpanga to stabilize the river bank and protect it from encroachment, supply tree seedlings to institutions from NRDI nurseries • Other partners in conservation - Kabarole Research and Resource Centre, Protos, SATNET and NFA
Willingness of urban authorities (leadership) to address climate change	• Tree planting is done on all new roads under USMID, Municipality and Uganda Road Fund projects • By-laws have been put in place to cut the eucalyptus trees and planting other tree species • Establishment of village environmental committees to protect the environment • Development plans approval requires that individual developers are climate change sensitive in their development plan

4. Socio-economic characteristics	
Population/demographics	• Total population 54,275 (66488 male and 27795 female), • Population growth rate of 2.3% per annum, • 21,677 (42.9%) is between 0-17 years – high dependency burden • The population is projected to be 108,209 in 2045 (2014 census)
Population density	• 1,356 people per sq.km
Urban poverty/economy	• Poor live in slums • Fort Portal is visioning a future city without slums, too beautiful and comfortable to live in by both the rich and the poor. • Slum population and people below poverty line. • Dependence of farming by most households
Per Capita GDP	• No data
5. Environment and ecosystems	
Ecosystems	• Encroachment on River Mpanga and other wetland ecosystems by urban developments and farming • Pollution of River Mpanga – oils from illegal washing • Land degradation – soil erosion also carries agro-chemical load, which pollutes the river • Deforestation due to urban pressure • Open spaces and wetlands have also been encroached on • Planting of Eucalyptus trees is threatening water tables in wetlands
Natural assets	• River Mpanga, wetlands • Fertile soils
Climate change response priorities	• Energy security/green energy • Detailed climate change vulnerability assessment of River Mpanga and catchments • Ecosystem restoration and management • Development of a climate smart physical development plan • Green tourism • Improvement in sanitation

7.2.5 Gulu Municipality





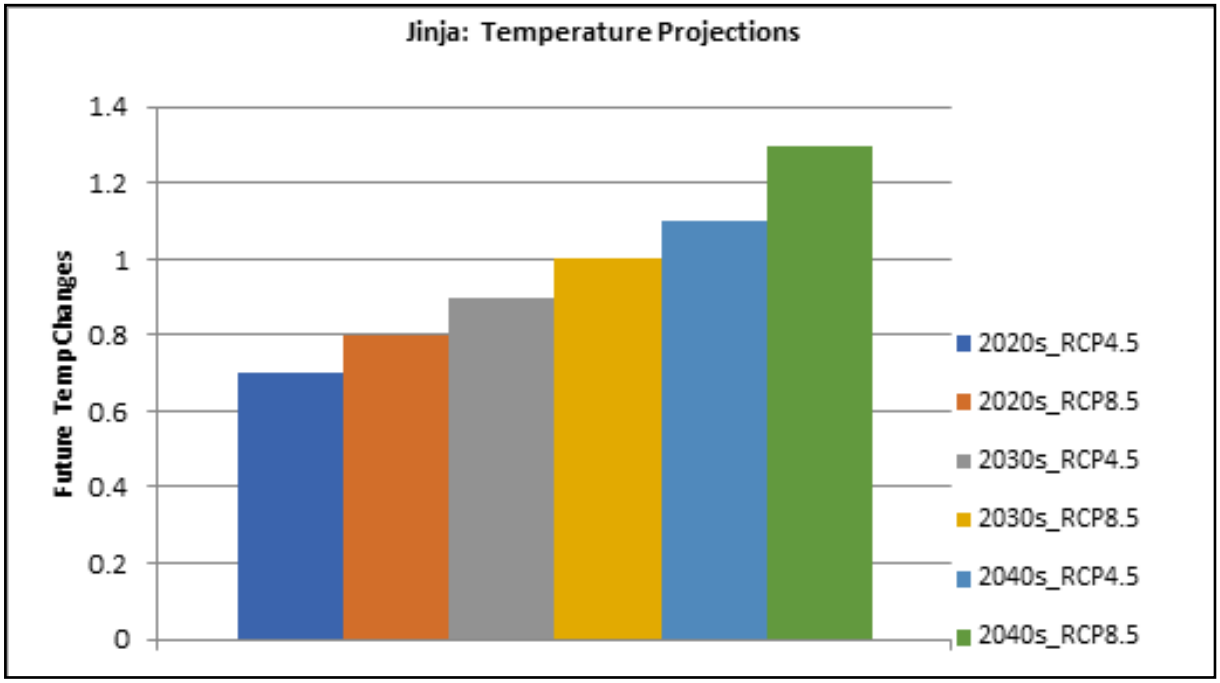
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 23.2^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.2^{o}C under RCP 4.5 scenario and 1.4^{o}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1396mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -6.4% under RCP 4.5 scenario and -4% under RCP 8.5 scenario

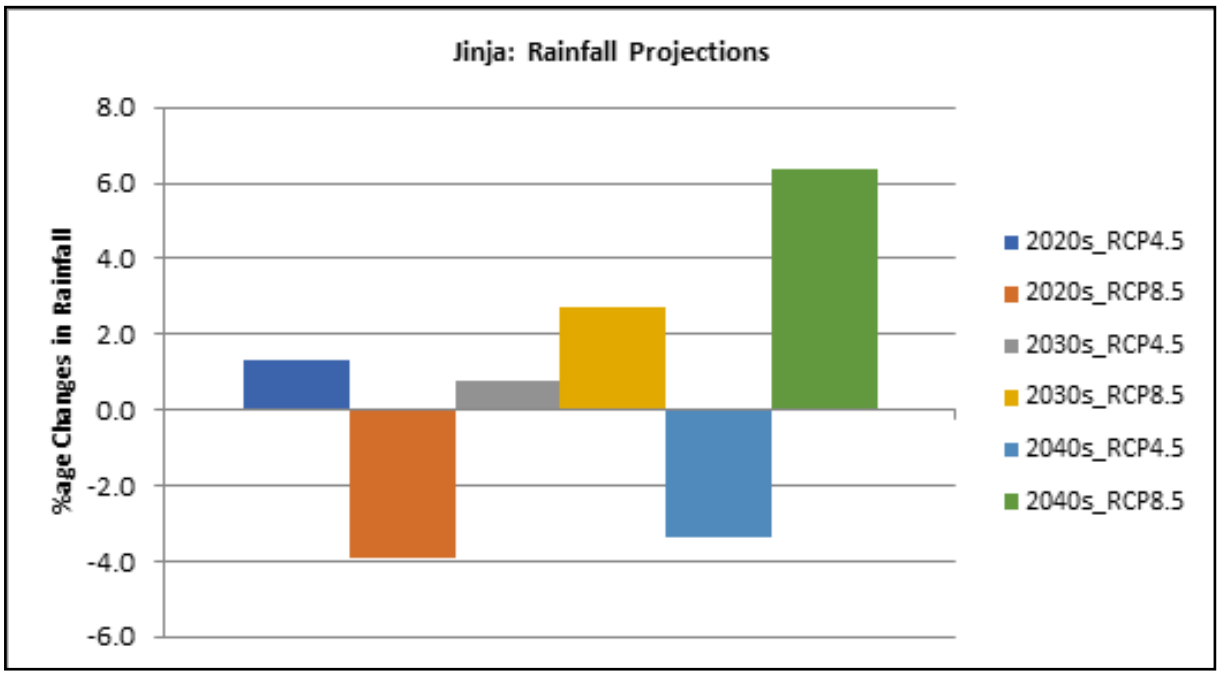
Extreme weather events	• Unpredictable/shifting seasons - especially the rain season and dry spells • Floods: more intense rainfall leading to flooding in the low lying areas • Droughts and heat waves - drying of streams and reduction in water table and farming • Extreme temperatures/heat waves
2. Infrastructure	
Water supply	• 10,721 (35.1%) households have access to piped water). (2014 census • 44.2% of households draw water from boreholes • NWSC supplies piped water– source of water is Oyitino dam constructed on Oyitino stream • Poiped water coverage/network is 47.5% of town (5 year Development Plan) • Water supply system constructed during colonial time - very low capacity compared to increasing population and so there is water availability problem • The dam has been drying period over the last two years – dries as early as December and by February there is no water till the April rains. • NWSC is looking at alternatives: sinking boreholes for emergency water supply, constructing a new dam - with support from Belgian government • Protected springs are another source of water for communities
Energy/electricity	• Electricity covers about 40% of the town are and serves nearly 48% of our population (5 year Development Plan) • 10,438 (34.1%) households had access to electricity (2014 census) • 31.3% use kerosene/tadooba for lighting • Electricity is not reliable with a lot of load shedding/power outages • Charcoal is the main source of energy for cooking; charcoal scarcity and prices are rising; • Little use of energy saving cook stoves • UNDP, PRELNOR are promoting sustainable energy technologies - cook stoves for homes and institutions, planting of woodlots for energy and sustainable charcoal production • Solar energy use is on increase - households and institutions • Solar street lighting provided on 9km roads under USMID • There is a proposal for Municipal offices and institutions to install solar - currently they use a generator when electricity is off • Proposal for solar lighting and motorized water pumping for Gulu market
Sanitation and sewerage	• The main sewer serves 12% of the Municipality, latrine coverage 79%, other use septic tanks • Sewer line (NWSC) is very old and overstretched - designed for a small population - frequent outbursts which are a health hazard • 114 (0.4%) of the households did not have any sanitation facility (2014 census).
Solid waste management	• CDM waste composting facility was planned but not accomplished – land was acquired, connected to electricity, water, planted trees and acquired equipment - wheel loader and tractor • However CDM composting project period ended and funds run out before the Gulu composting plant/project commenced. • Has a landfill at Laroo; for waste collection and disposal – open dumping

	• Only 40% of the waste generated is collected • 19,380 (63.4%) households properly disposed off solid waste (2014 census).
Storm water drainage	• Drainage channels on 9 km USMID roads constructed to handle wastewater.
Transport	• Both paved and unpaved roads • 9 km tarmac road – USMID support • Through the Uganda Road Fund, 1 km is tarmacked annually • Through USDMID project a drainage master plan has been prepared, but is not yet implemented.
Housing	• Poor housing conditions with poor sanitation resulting in poor health condition for the population especially in areas of Kony Paco (where people are reported to be defecating in kavera) Limu, and Pece-Lukung (5 year Development Plan) • 17,683 (57.8%) households live in dwelling units constructed using permanent roof materials, 53.2% permanent walls and 50.3% permanent floor material, 20.0% of the households live in semi-permanent dwelling units while 35% in temporary, 28,176 (92.2%) did not live in decent dwellings
3. Governance	
Planning	• 20 year - Physical Development Plan 2015 – 2035 • 5 year development plan 2015/16 – 2019/20 • Municipal Development Strategy 2016-2040 – USMID support • Drainage Master Plan – USMID support • Solid Waste Management strategy – USMID support
Financing	• 5 year development plan does not incorporate climate change • Municipality joins hands with the District in tree planting, regulating charcoal production to reduce deforestation • In process of beautifying the city • NUSAF3 has a component of climate change – protection of water catchments and wetlands • Climate change and other crosscutting issues depend on local review, which is very small
Participation	• UNDP, PRELNOR etc – promoting sustainable energy technologies (cook stoves) for homes and institutions; • Support planting of woodlots for energy and sustainable charcoal production • Working with World Embrace in environment and climate change • PRELNOR project engage in sustainable energy technologies (cook stoves) for homes and institutions, Supports planting of woodlots for energy and sustainable charcoal production • Community infrastructure/roads but this is outside the Municipality • Community based natural resource management – support for preparation of 600 community management plans. • Integration of irrigation and energy issues (solar based irrigation) – depending on community priorities • Works with ICRAF on sustainable land management
4. Socio-economic characteristics	
Population/demographics	• Total population 152,276, • Annual growth rate 3.0%, • 60 % below 18 years, 47% below 15 years – implying high dependency burden (2014, census)
Population density	• 2,079 People per sq.km

Urban poverty	• Unemployment and under –employment – lack skills and semi skilled • In slum areas like Vanguard, Limu, Kony-Paco, Pece-Lukung, Cerelenu, Kanyagoga, Cuk pa Oweka and Town Center - indiscriminate sexual activities and prostitution are practiced (5 year Development Plan)
Percentage of urban areas susceptible to climate hazards	• Floods affect all wards in low land areas (5 year Development Plan)
Per Capita GDP	• No data
5. Environment and ecosystems	
Ecosystems	• Draining of wetlands in the town and surrounding areas • There are plans to degazzete Laroo CFR to allow for expansion of Gulu city - alternative land for swapping with NFA for the forest has already been identified and acquired - NEMA and NFA have approved the degazettement but now waiting for approval by Parliament • Environmental problems - drying of streams are caused by environmental degradation upstream/highlands due to deforestation, bush burning etc. • USMID support has a component on beatification.
Natural assets	
Climate change response priorities	• Eco-friendly (green) solid waste management – implementation of solid waste management plan • Climate resilient water supply/security and water resource management • Ecosystem restoration and management • Energy security/renewable energy; energy efficient cook stoves • Improved sanitation • Flood/waste water management

7.2.6 Jinja Municipality





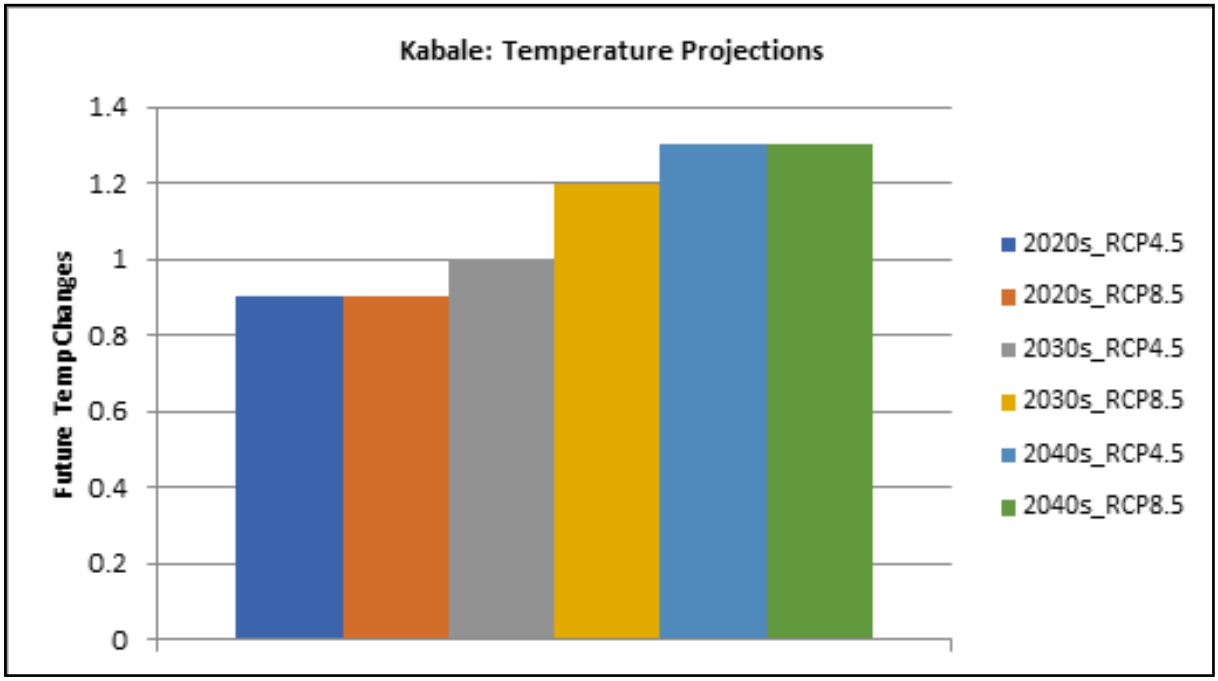
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 22.1^{0}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.1^{0}C under RCP 4.5 scenario and 1.3^{0}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1275mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -3.4% under RCP 4.5 scenario and +6.4% under RCP 8.5 scenario

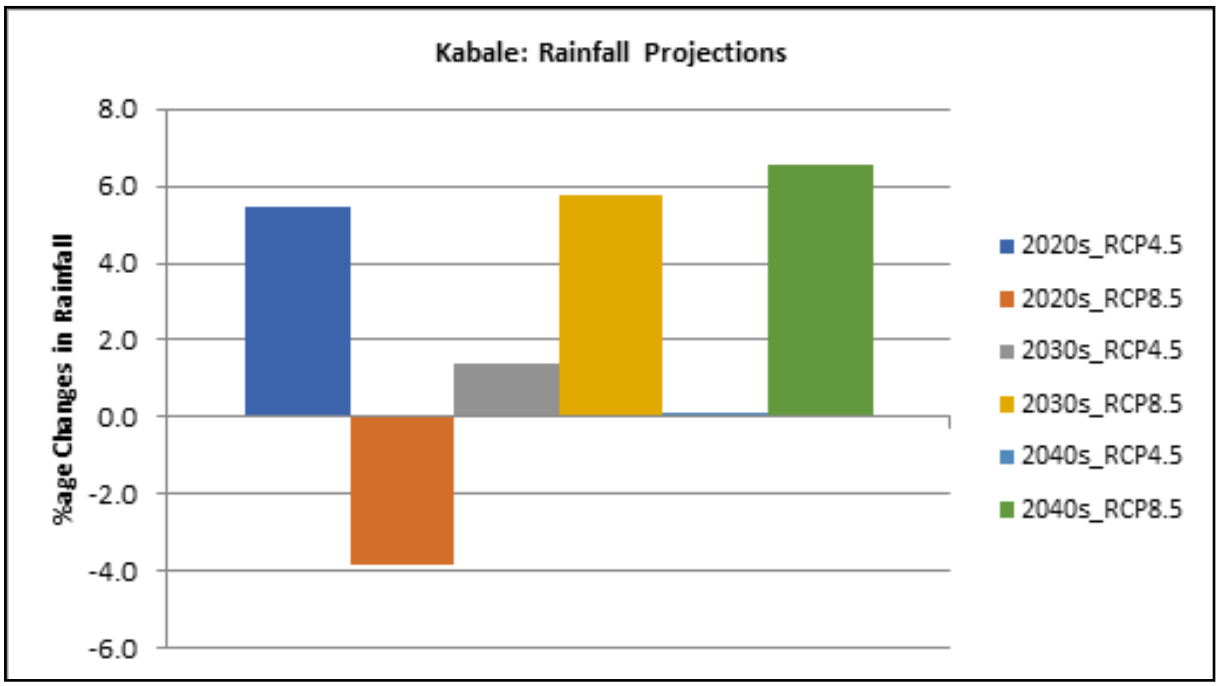
Extreme weather events	• Extreme temperatures and heat waves • Extreme rainfall – high intensity • Flooding - MMI area and Walukuba Estate • Droughts are threat to agriculture food security and water security • Droughts cause a lot of dust in town.
2. Infrastructure	
Water supply	• Piped water by NWSC – source of water is Lake Victoria • 7,552 (94.3%) households had access to piped water, 0.8 % used boreholes (2014 census) • Piped water coverage/network is 90%, reliable supply. • High water connection costs and water tariffs – not affordable by poor • Boreholes, wetlands, wells are also source of water for some households and institutions • Rainwater harvesting is done by a few me households and industries • Water pollution from industries - NWSC complains of the need for more chemicals in water treatment
Energy/electricity	• Electricity coverage more than 67% - mainly used for lighting • 5,580 (69.7%) households in Jinja Municipality West had access to electricity for lighting while 15% used kerosene/tadooba. In Jinja Municipality East, 5,646 (49.2%) had access to electricity and 31.5% used kerone/tadooba for lighting • Solar also used for lighting • Street solar lighting - USMID support • Thermal generators used for business during load shedding • Charcoal and wood fuel dominates cooking - charcoal covers 20%, biomass 8%, petrol 15%, firewood 28%, and electricity 14%. Biogas is also used. . • Plan to install municipal hall and markets with solar • Coffee and groundnut husks used to steam water in industries
Sanitation and sewerage	• Reminiscent in dilapidated housing infrastructure with inadequate sanitary facilities - settlements of Soweto, Danida, Kibuga Mbata, Walukuba housing estate, Mailo Mbiri, Loco village, Kimaka, Kamuli road village and the police barracks • Sewer line coverage is small - illegal connections to sewer lines • Frequent breakdown of sewer lines - wastewater mixes with storm water –health hazard. • Manholes stolen for scrap • Septic tanks and pit latrines also used • Flying toilets (polyethylene bags) - water borne diseases • Collapsing toilets due to floods • 82 (0.7%) of the households did not have any sanitary facility in Jinja Municipality East. 64 (0.8%) of households in Jinja Municipality West did not have sanitary facilities (2014 Census)
Solid waste management	• Has CDM waste composing facility - earns carbon credits • Some composting done and recycle by the unemployed • About 50% of waste is collected - central business district and markets • Backyard and open dumping are usually practiced • 6,846 (85.5%) households in Jinja Municipality West properly disposed off waste. In Jinja Municipality East, it was 9,987 (86.9%) – 2014 Census

Storm water drainage	• Drainage Master Plan prepared under USMID support • Big drainage channels have been proposed • Drainage improved along USMD roads - Nalufenya road
Transport	• Paved Nalufenya road - USMID support - next phase, the main street will be worked on • Solar street lighting on USMID roads
Housing	• In Jinja municipality there are independent household 2,000, independent flat, 4,793 households, shared 6,914, others 343 households (5 year Development Plan) • 1,523 (19.0%) households live in semi-permanent dwellings while 1.3 % live in temporary dwellings, 6,006 (75.0%) of the households did not have decent housing in Jinja Municipality West. In Jinja Municipality East 5,346 (46.5%) households live in semi-permanent dwellings while 0.5% live in temporary dwellings, 10,085 (87.7%). of the households did not have decent housing (2014 Census) • Jinja Municipality West 7,859 (98.2%) of the households have dwelling units with permanent roofing material, 81.8 % permanent wall and 86.0% permanent floor.
3. Governance	
Planning	• Has a Structure Plan 2009 – 2019 • In the process of coming up with city model planning integrating all sectors - environment, engineering and economic planning • Environmental Action plan exists • Solid Waste Management Strategy prepared- USMID support • Drainage Master Plan in place - USMID support
Financing	• Climate change issues are not covered • Environmental issues are integrated in development plans • Municipal Development Strategy - greening and renewable energy are considered • Need to mainstream climate change in the Local Government assessment manual like environment
Participation	• The MWE in 2016 put efforts to identify survey and gazette wetlands. This is still work in progress
Administrative units assigned to address climate change and disaster risk management	Government units authorized to handle climate change and disaster risk management
Willingness of urban authorities (leadership) to address climate change	• Municipal resolution to ensure that all new buildings have solar installation • Environment theme - people encouraged to embrace use of renewable energy • Planning sustainable neighbourhoods/communities to limit need for travel with automobiles • Plan to have public municipal transport system like buses as was before that increased use of motorcycles 'boda boda' • Plan to make briquettes from solid waste as alternative source of energy for cooking • Municipal bye-law that restricts tree cutting including cutting of tress on private land. • Water harvesting - hotels, schools, homes • Central market - underground water tank to harvest water • Plan to come up with a policy to promote renewable energy use • Municipal roof and Central be installed with solar panels • Institutions and industries encouraged - support solar street lighting • Housing architecture – natural lighting and energy/water efficiency

4. Socio-economic characteristics	
Population/demographics	• Total population 76,057, (39,612 male and 36,442 female), (2014 census)
Population density	No data
Urban poverty	Slum population and people below poverty line.
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Encroachment on wetlands - floods occur in MMI industrial area and Walukuba housing estate. • Conversion of environmentally sensitive areas for industry and residential - natural drainage channels blocked e.g. in Bugembe • Reduction of carbon sinks by development • Encroachment on open spaces for development e.g. Chairman's park opposite the agriculture show ground and Nile garden • Tree planting culture is low • Industrial effluent discharges and hazardous solid waste from the tanneries, oil factories and paper industry • Wastewater treatment systems of factories – a challenge
Natural assets	• Lake Victoria
Climate change response priorities	• Develop a stand alone Municipal climate change strategy/plan • Climate proofing physical development planning process • Investments in green energy and energy efficiency • Green waste management • Flood management and control • Ecosystem restoration and management • Water security (rain water harvesting)

7.2.7 Kabale Municipality



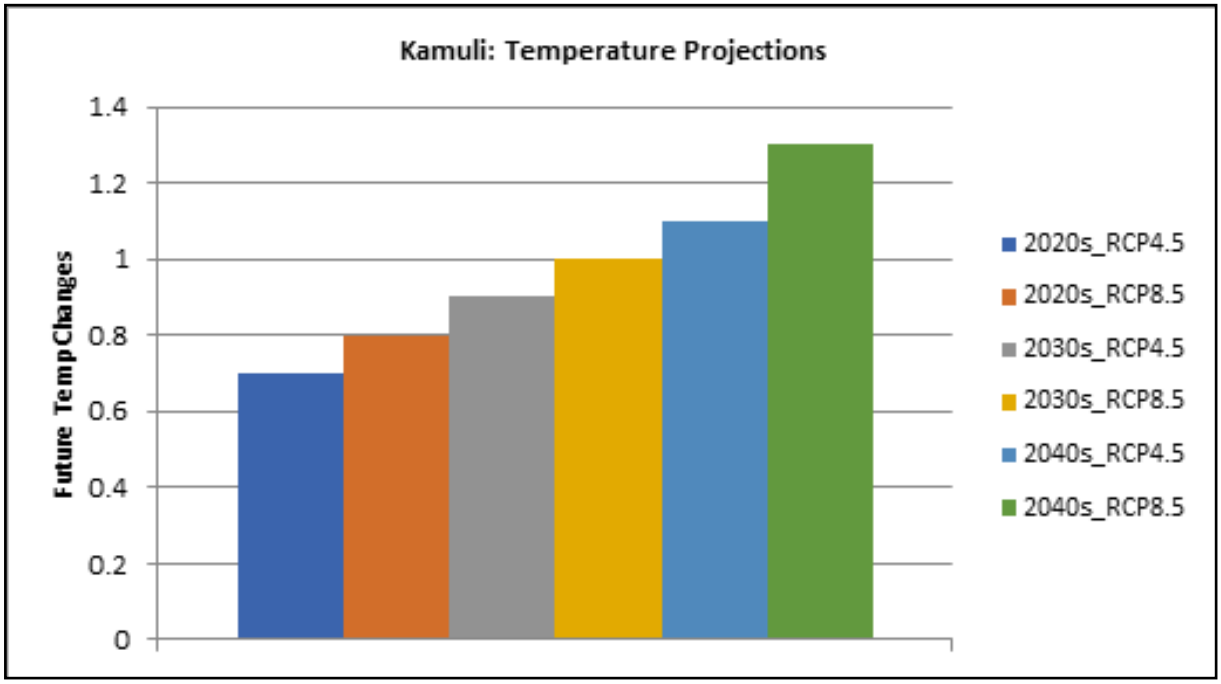


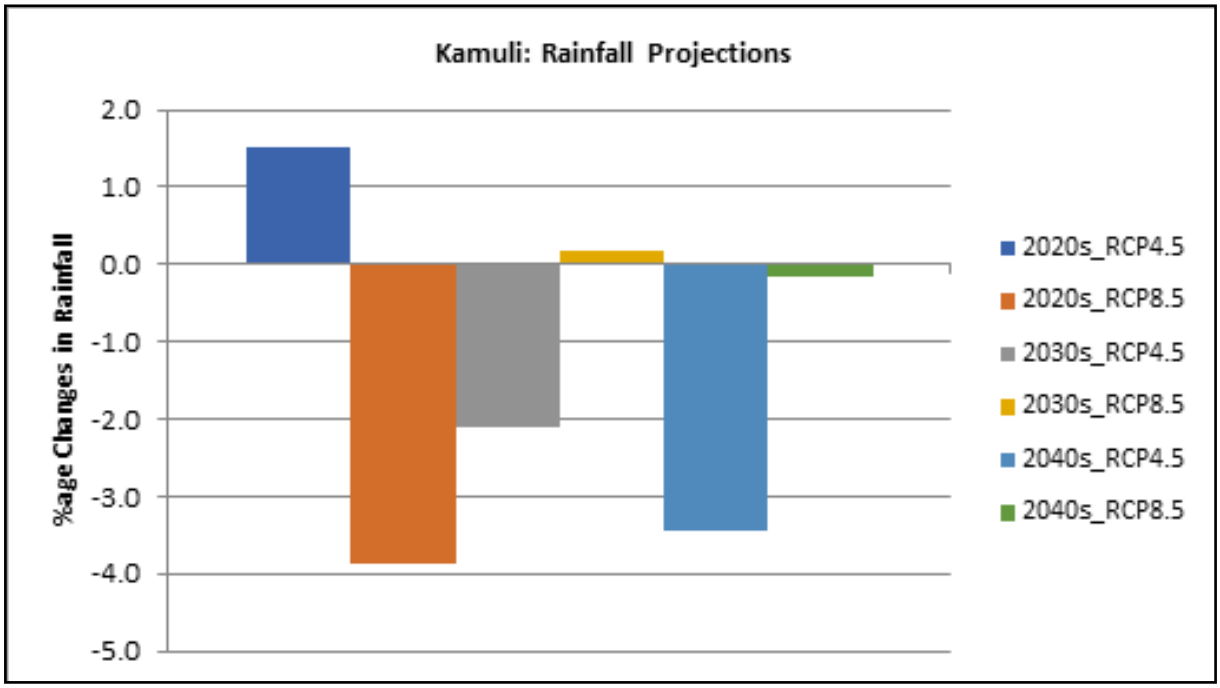
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 17.6^{0}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.3^{0}C under RCP 4.5 scenario and 1.3 ^{0}C under the RCP 8.5 scenario.
Rainfall – observed trends (1975 – 2005)	• Annual mean 1204mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by +0.1% under RCP 4.5 scenario and +6.5% RCP 8.5 scenario

Extreme weather events	• Extreme temperatures and heat waves • Extreme rainfall • Flooding in lower areas: attributable to developments on slopes – triggering run-off - Makanga hill, Golf Course, Bugongi and Mwanjari • Increased drought occurrences – rising food insecurity
Exposure to other hazards	• Landslides, diseases (malaria and water borne diseses)
2. Infrastructure	
Water supply	• 6,552 (56.1%) households have access to piped water and 3.8% use boreholes (2014 census) • Lake Bunyonyi is the source of piped water supply by NWSC • Piped water coverage: CBD, Central Division and the lower part of Southern Division • Two gravity flow water schemes: Ndorwa hill above Kabale University and Rushaki/Kihumuro hill, Nyarunkonkomi • Protected springs and boreholes also used as water sources • Reducing water yields in springs and gravity schemes. • Pollution - open springs and protected springs polluted by solid waste and waste water from garages, washing bays and slaughterhouses
Energy/electricity	• 6,366 (54.5%) of the households had access to electricity for lighting while 14.2% used kerosene/tadooba • Electricity supply is unreliable – power outages and load shedding. • Charcoal and firewood used for cooking • Solar street lighting on roads supported by USMID • Promotion of energy saving cook stove
Sanitation and sewerage	• Sewer line by NWSC serves only about 20% of the population • Pit latrines and septic tank dominate • 25 (0.2%) of the households in the Municipality did not have any sanitation facility (2014 census) • High use of pit latrines but Kabale has a high water table - health risks • Water contaminated by flooding - health risk
Solid waste management	• Has a functional CDM composting facility • Communal waste collection system practiced, coverage about 70% • 6,731 (57.6%) of the households properly disposed off waste (2014 census) • Illegal dumping along the roadside and streams- plastic bottles, polyethylene bags and construction debris
Storm water drainage	• Storm water exceeds capacity of existing drainage system • Poor waste management - dumping of waste in drainage channels
Transport	• Unpaved roads damaged by floods, storms and landslides • Many paved roads are in poor state – pot holes • Endeavours to improve municipality road network and drainage systems therein in annual budgets • Road improvements on going with USMID support.
Housing	• 11,653 (99.8%) of the dwelling units were constructed using permanent roof materials, 59.4% permanent wall material and 74.7% permanent floor material, 43.2 % live in semi-permanent dwellings while 0.1% in temporary, 10,059 (86.1%) of the households do not live in decent housing (2014 Census)

3. Governance	
Planning	• Structure Plan 2008-2018 - new Physical Development Plan is being developed • 5-year Development Plan 2010/11 – 2014/15: the one for 2015/16 – 2019/20 plan not yet completed • Municipal Development Strategy 2016-2040 in place – USMID support • Solid Waste Management Strategy in place - USMID support • Drainage Master Plan in place – USMID support; not yet implemented. • Environmental Action Plan 2016 – 2021 in place.
Financing	• Climate change not yet mainstreamed in planning and budgeting
Willingness of urban authorities (leadership) to address climate change	• Willing to climate proof the Physical Development Plan being developed. • Environmental inspections are conducted when applying for land title • Emphasis is put on buffers for fragile ecosystems – wetlands, streams • Have an environmental action plan
4. Socio-economic characteristics	
Population/demographics	• Population 49,201 (2014 census) • 27,067 male and 22,134 female, 42.6 % is below 18 years meaning high dependency burden
Population density	• No data
Urban poverty	• Agriculture – affected by droughts • Subsistence farming • Un employment is high especially youth • High potential for urban agriculture and green tourism
Per Capita GDP	• No data
5. Environment and ecosystems	
Ecosystems	• Wetland encroachment - almost all wetlands have been converted to dairy farming, seasonal crop production, tree planting and construction • Flooding is thus a serous challenge in the lower areas • Developments on slopes • Siltation of rivers and drainage channels
Natural assets	• Beautiful landscape
Climate change response priorities	• Development of a standalone climate change strategy/plan • Climate proofing physical development plan • Energy security and access: renewables like solar, biogas, energy efficient cook stoves • Water security: water storage/harvesting • Ecosystem restoration and management/ water catchment management • Green tourism development • Flood/waste water management

7.2.8 Kamuli Municipality





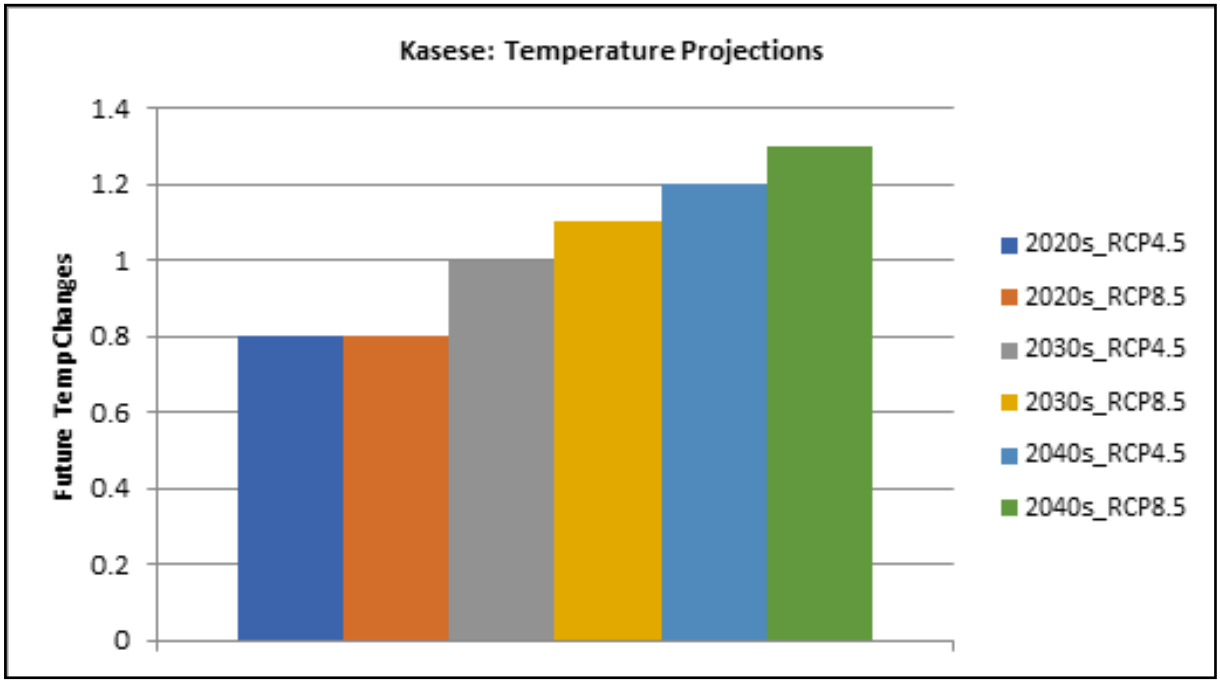
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 22.4^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.1^{o}C under RCP 4.5 and 1.3 ^{o}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1188mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -3.5% under RCP 4.5 and -0.2% under RCP 8.5 scenario

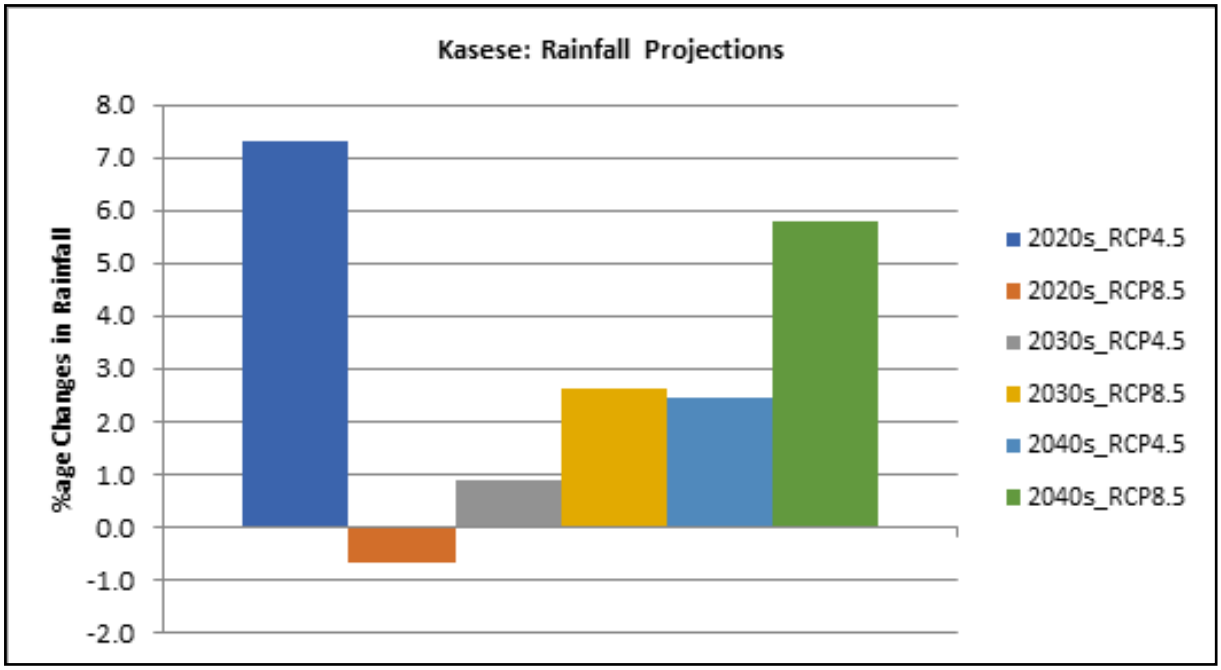
Extreme weather events	• Extreme temperatures and heat waves • Prolonged droughts - affect agricultural productivity leading to low crop yields, lack of fodder for animals, food insecurity and hiked prices • Extreme rainfall events, storms resulting into run-off, siltation, soil erosion, destruction of buildings • Flooding e.g. Mulamba ward
Exposure to other hazards	• Water borne diseases like cholera, dysentery and malaria are prevalent • Pests like new breed of ticks that is resistant to pesticides and armyworms that affected maize production
2. Infrastructure	
Water supply	• Piped water supply by NWSC - about 60% coverage • Source of water is from Namalembe dam, plans to increase water coverage by tapping water from River Nile • 1,168 (8.9 %) households had access to piped water (2014 census) • 78.4 % used boreholes • Old water infrastructure - asbestos pipes, now being replaced by plastic pipelines • Boreholes and wells, springs and swamps also main sources of water • In some areas humans and livestock share water sources • Flooding leads to contamination of water sources • Silting common at the unprotected water wells • Droughts affect water availability - reduction of water in the dam, wells and springs and boreholes
Energy/electricity	• Only 3,528 (26.9%) of the households used electricity for lighting while 50.8% use kerosene/tadooba • Unreliable electricity; frequent power outages and load shedding • Storms affected electricity distribution network • Charcoal and firewood are widely used for cooking – main source of charcoal is Buyende District • Limited use of LPG and biogas for cooking • There is limited use of energy saving cook stoves - • Minimal use of solar
Sanitation and sewerage	• Municipality has no central sewer system • Mainly pit latrines and septic tanks are used • 217 (1.7%) of the households did not have any sanitation facility (2014 census) • Plan to construct a faecal treatment plant at Kiwolera • Floods affect sanitation - pit latrines breakdown posing a high danger of health

Solid waste management	• Waste collection and disposal is the practice • Municipality has no site for waste disposal • Waste is transported to farmers who need it for manure • Very old vehicles for solid waste collection – breakdown • Solid waste bankers - GOES (from Netherlands) provide support to separate waste, but this is failing and people do not separate the wastes • Municipality has plastic grave bailer to crush and compress the plastic waste and prepare it for recycling • Indiscriminate dumping blocks drainage channels hence flooding • Only 6,827 (52.1%) of the households properly disposed off waste (2014 census)
Storm water drainage	• No proper drainage on roads • Water logged areas when it rains • Flooding leads to destruction of infrastructure – roads and bridges • Open drains are a danger
Transport	• Both paved and unpaved roads - 15.37 kilometres of roads is paved • Presidential pledge - roads being tarmacked with good drainage
Housing	• 12,847 (98.0%) of the households lived in dwelling units constructed using permanent roof materials, 87.3% permanent wall material and 60.5% permanent floor material (2014 census). • 5,105 (38.9 %) lived in semi-permanent dwelling units while 1.7% in temporary dwelling units and 95.2% of the households did not live in decent housing
3. Governance	
Planning	• Structure Plan 2009 – 2019 but the plan covers only four wards out of ten. The six rural wards become part of the Municipality when Kamuli was elevated to municipal status • 5 year Development Plan is being developed for the period 2016/17 -2019/20 coded Development Plan II. • The Previous 5 year development plan was for Kamuli Town Council • No Municipal Development Strategy • Environmental Action Plan exists at the District • No Municipal Environment Officer
Financing	• Kamuli does not receive funds to support climate change • Unconditional grants - mobilized to recruit Natural Resource Management Officer
4. Socio-economic characteristics	
Population/demographics	• Population 58,984 - (28,049 are male and 30,935 female), • Annual growth rate is 2.54% • 56% below 18 years (2014 census)
Population density	• 574.6 people per sq.km

Urban poverty/econmy	• Informal sector constitutes the biggest proportion - small entrepreneurs and flexible but non-permanent employment • Prolonged drought leads to loss of local revenue resulting from low agricultural production - crop failure due to climate change means failure of business people to pay license • Boda-boda • Industries - metal fabrication, milling (rice, maze etc.), coffee hurling • Markets • Transport terminal • Shops • Hotel industry • Abattoir - cattle and pigs • Tourism is a potential e.g. Kaguru hill but not developed
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Encroachment on wetlands • Two gazetted green belts in Mulamba ward - not yet developed and there is competition with other land uses like market • Deforestation and destruction of vegetation for agriculture • Charcoal burning and bush burning - destroying ecosystems
Natural assets	
Climate change response actions	• Development of a stand alone climate change strategy/plan • Solid waste management (greening waste management, composting and recycling) • Water security, investment in water harvesting • Urban agriculture • Climate proofed physical development plan • Sustainable/green energy – solar, biogas, efficient energy cook stoves.

7.2.9 Kasese Municipality





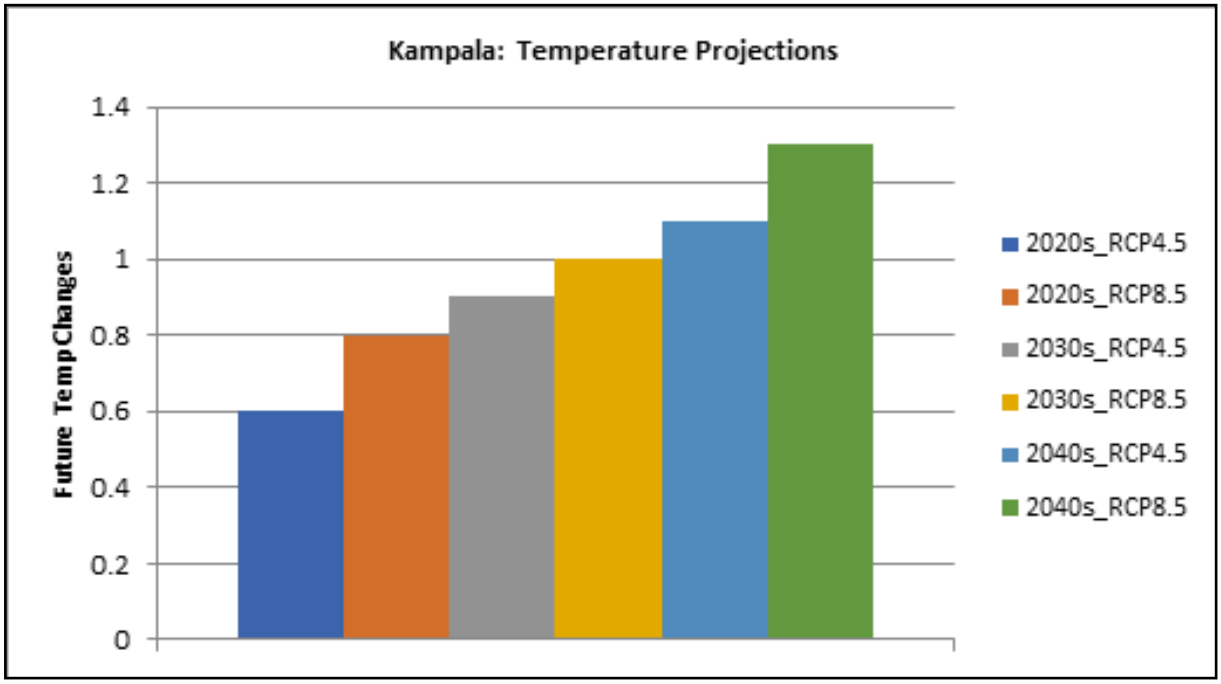
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 23^{0}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.2^{0}C under RCP 4.5 and 1.3^{0}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 969mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by +2.4% under RCP 4.5 and +5.8% under RCP 8.5 scenario

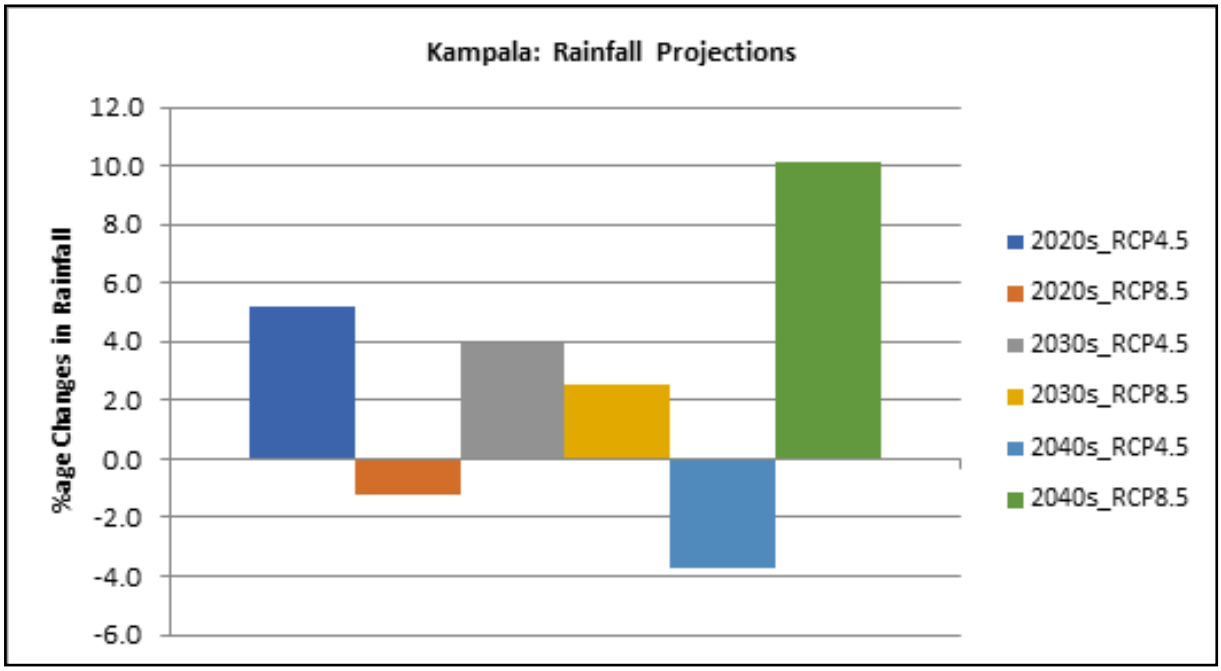
Extreme weather events	• Extreme temperatures and heat waves • Unpredictable rain seasons • Prolonged drought and dry spells - affect crops leading to food insecurity • Extreme rainfall events and storms - surrounded by hills, sometimes flooding occurs even when it has not rained in the Municipality • Flooding is common along Kasese- Mbarara road - Other areas prone to flooding are Nyakabingo and Kihara, Bunyamwongo and Kilembe • River Nyamwamba often overflows and people around the river are affected • Roads and crops are destroyed and animals also die • In areas like Nyakasanga and Prisons are dry yet other parts are flooded
Exposure to other hazards	Landslides etc.
2. Infrastructure	
Water supply	• 21,52 (84.4 %) of the households have access to piped water while 1.4% use boreholes (2014 census). • River Nganji in the mountains is source for piped water supplied by NWSC • Water source is seriously affected by silting - NWSC stops water supply due to dirty source during rainy season • Gravity flow scheme cover Kirembe and Kigoro areas • Boreholes, protected springs, rivers are also used – floods contaminate these sources • Prolonged drought – boreholes get dry
Energy/electricity	• 10,961 (43.0%) of the households used electricity for lighting while 29.8% used kerosene/tadooba (2014 census) • Electricity is largely reliable - generation in Kilembe • Charcoal and firewood used for cooking - charcoal comes from Mubende, Bundibugyo and Kyenjojo • Limited use of solar is in some households for lighting • Street lighting is by hydropower.
Sanitation and sewerage	• No central sewer system • Septic tanks and pit latrines are used • 85 (0.7%) do not have any sanitation facility (2014 census) • Given the terrain – downstream water sources - wells, rivers and protected springs are polluted • Outbreak of cholera is common in the Municipality
Solid waste management	• Has a CDM solid waste composting facility– sorting is done at compost facility at Kidodo • Only 70% of waste generated is collected - limited funding is a challenge in ensuring daily collection – vehicle breakdown • Dumping of waste on roadsides and drainage channels is common • 19,537 (76.6%) households properly dispose off their solid waste (2014 census).

Storm water drainage	• Poor drainage system. • Runoff blocks the existing few drainage channels due to silting • Gullies are common on roads due to runoff.
Transport	• Total of 210 km of which only 9km are paved • Stone road pitching and culverts for drainage is expensive for the municipality • Road development done in phases and by the time drainage is thought about, some sections of the road will have been washed away by storm water
Housing	• 5,054 (98.3%) households live in dwelling units constructed using permanent roof materials, 90.2% permanent wall material and 71.3% permanent floor material. • 71.3 % live in semi-permanent dwelling units while 1.4% in temporary and 92.78% of the households do not live in decent housing (2014 census)
3. Governance	
Planning	• Has Structure Plan 2008 – 2018 • 5- year Development Plan 2015/16 – 2019/20 • No municipal development strategy • No environmental management plan • No municipal drainage master plan
Financing	• Environmental project profiles in the budget – but budgets are not realized • Roads and school - upgrades take care of tree planting
Participation	• Some tree planting efforts e.g. the Lions Club Kasese has been allocated some open space in Butsumbamuro to plant more trees • Other partners in tree planting include South Rwenzori Diocese, Obusinga bwa Rwenzori, NWSC, NFA, Lottery Club and Kabarole Research and Resource Centre
Willingness of urban authorities (leadership) to address climate change	• In partnership KCCA - Kasese Municipality is to come up with a Sustainable Energy and Climate Change Action Plan (SECAP) • Established tree nursery where the community is given free trees • Sensitization campaigns - including in schools are undertaken by environment committee to protect the rivers, wetlands and other ecosystems
4. Socio-economic characteristics	
Population/demographics	• Total population - 101,679 (48,316 male and 53,363 female), • Annual population growth rate 7.4% • Projected population: 125,959 in 2017 and 156,041 in 2020, (5 year Development Plan)
Population density	• 660 persons per sq.km

Urban poverty	• 1996-2000 war aggravated the problem of poverty among households and community i.e. created poverty pockets in Railway village, Kiteso in Kamaiba Parish where 80% of the population is unemployed, Kanyangeya Main, Saluti A & B in Kanyangeya Parish where the main, Source of livelihood is brick making, Umoja and Kisagazi in Nyakasanga I with evidences of slum settlements, Mumbuzi, Nyamwamba and Kitoro in Nyakasanga II where much of the Population is IDPs, Base-camp Lower in Base-camp Parish where low income earners live, Kighalimu and Katadoba in Nyakabingo II subsistence farming is Common, Kemihoko in Bugoye, Masule in Bulembia (5 year Development Plan)
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• River Nyamwamba traverses Kasese Municipality with numerous tributaries and wetlands - but these have been severely encroached on by developments especially agriculture • Degrading of river banks • Rivers have lost capacity to contain storm water hence flooding • Agriculture practices upslope are causing land degradation - increasing erosion and silting downstream. • Terraces are not effective in holding the soils since the hills are too steep • Droughts hampers tree planting - the planted trees end up drying because the Municipality cannot afford to water them
Natural assets	• Rivers, streams
Climate change response priorities	• Developing a stand-alone climate change strategy/plan (detailed vulnerability assessment, covering sustainable energy and air quality). Process has begun with support from KCCA. • Sustainable solid waste management (green practices) • Flood management/waste water management • Sustainable energy planning and energy security: renewables – solar, biogas, energy cook stoves • Water security: quality, storage/rain water harvesting. • Ecosystem restoration and management • Tree painting and greening the city • Climate proofed physical development plan.

7.2.10 Kampala Capital City and Greater Kampala Metropolitan Area





Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 22^{0}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.1^{0}C under RCP 4.5 and by 1.3^{0}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1390mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -3.8% under RCP 4.5 and +10.1% under RCP 8.5 scenario

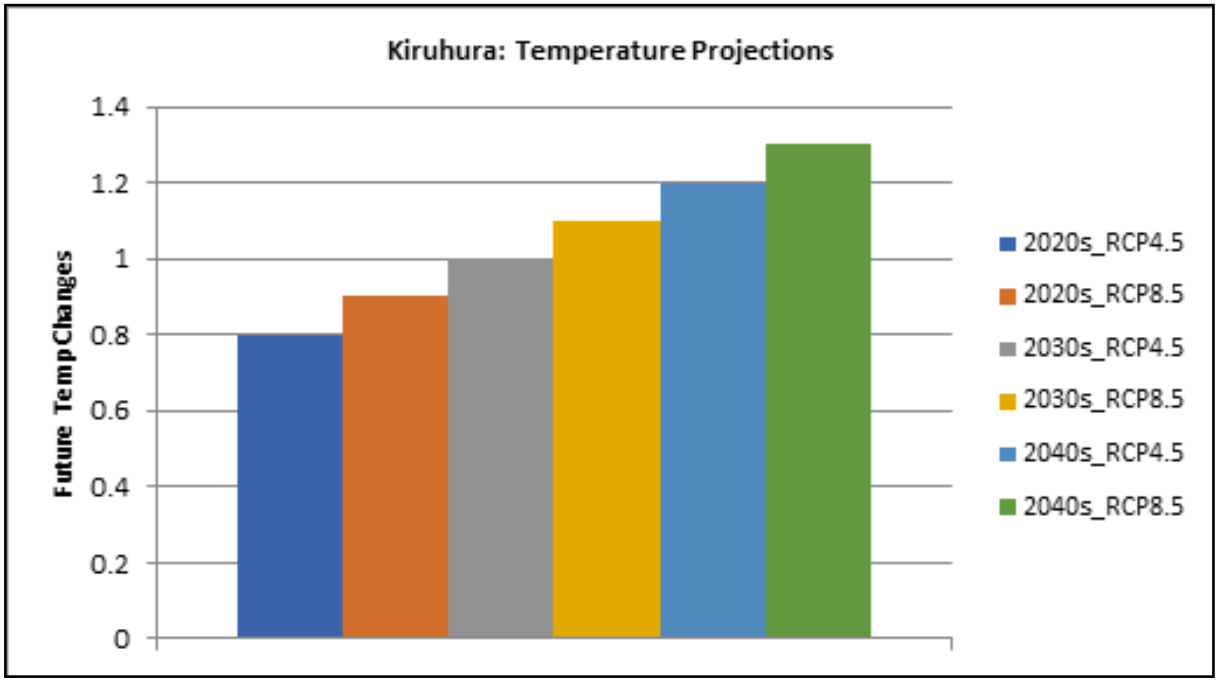
Extreme weather events	• Extreme temperatures and heat waves • Droughts • Extreme rainfall and storms, • Floods in places like – Kalerwe, Bwaise, Kyambogo, Nateete, Nalukolongo, Ndeeba, Katwe, Clock Tower and Namasuba
Exposure to other hazards	• Flooding – water borne diseases like cholera, typhoid and malaria due to favourable breeding grounds for mosquitoes
2. Infrastructure	
Water supply	• NWSC supplies piped water – source is Lake Victoria • 82.5% of the households (341,841) have access to piped water while 0.9% use boreholes (2014 Census) • Water supplies are not reliable. • Access to safe drinkable water is a challenges in Kampala City slums • Overall, 25% of households do not have access to safe water sources (Development Research and Training *http://drt-ug.org/2016/11/08/*)
Energy/electricity	• Energy for cooking is dominated by biomass (charcoal and firewood) • Electricity dominates lighting and industry • 84.2% (349,032) households have access to electricity for lighting (2014 Census) • 2.8% (11,514) households use kerosene/Tadooba for lighting • KCCA plans to revamp the entire street lighting – install solar lighting • Initiatives are on to convert the waste to energy
Sanitation and sewerage	• Has a central sewer system by NWSC • Sewer connection covers only 7.3% of the population, mainly the CBD and the affluent areas (5 year Strategic Development Plan) • 92.7%, rely on various forms of on-site sanitation - pit latrines and septic tanks • 0.4% (1,671) of the households do not have any toilet facility (2014, census) • Poor sanitation facilities, coupled with the lack of hygiene knowledge and practices are evident in the low-income settlements • High incidence of sanitation related illnesses such as diarrhoea and cholera • In Kawempe and Makindye 16% and 4.2% of households use paid for public toilets. • In one of Makindye slum a public toilet is located in another zone and serves 3 zones (Development Research and Training *http://drt-ug.org/2016/11/08/*)

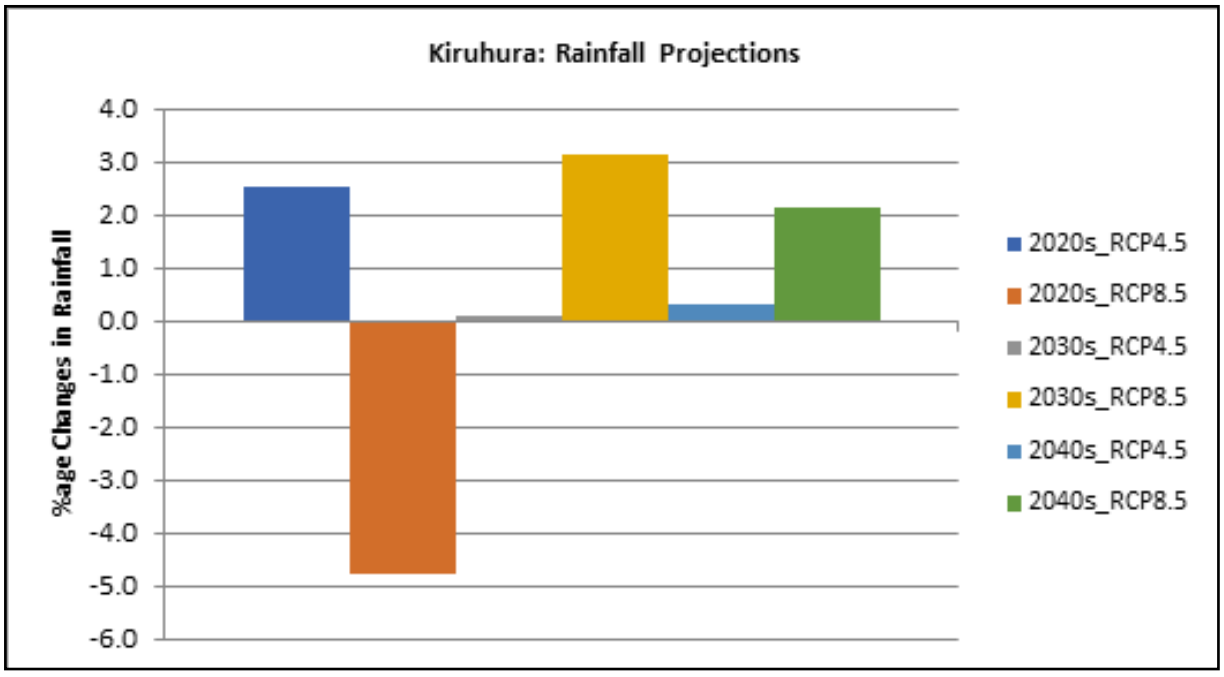
Solid waste management	• 88.0% (364,635) of the households properly dispose off solid waste (2014 census) • Solid waste daily tonnage is estimated to be 60,000 tons • 75% of waste generated is organic in nature, with plastics (12%) and paper and board (11%) making up the next largest categories. The small remainder includes glass, textiles, and metal (5 year Strategic Development Plan) • Over 700 litter bins were distributed in the CBD, Schools and Hospitals (5 year Strategic Development Plan) to promote responsible solid waste disposal • 66% of waste is disposed by means other than use of a landfill • Site - burning of refuse, illegal dumping of waste by refuse collectors or building contractors, household dumping of waste into storm water channels, sewers or public areas, and incineration of waste. These disposal practices manifest themselves in health problems, blockage of drainage systems, air pollution, odours, and degradation of the urban environment • Kampala has an Integrated Solid Waste Management strategy • Private operators provide door-to-door collection in affluent communities • Waste is disposed at Kiteezi - almost filled up and imminent environmental issues arise • Plans to covert landfill gas into electricity.
Storm water drainage	• Kampala is drained by channels like Nakivubo, Lubigi, Nalukolongo, Kinawataka, Nyanama-Walufumbe and Kansanga – • Functionality of the drainage system is limited by encroachment, poor condition and lack of adequate maintenance
Transport	• Kampala has approximately 1,200km of which only 20% are in fair condition • Road network was constructed for less than 100,000 vehicles in the 1960s and yet today over 400,000 vehicles use the same roads • Most of the roads have outlived their usefulness and need total reconstruction and expansion (5 year Strategic Development Plan) • Traffic and business have been overwhelmingly disrupted by flood e.g. along Clock Tower and Kyambogo • Traffic congestion inhibit mobility • Under KIIDP2, road infrastructure and drainage are being improved.
Housing	• 99.7% of the households live in dwelling units constructed using permanent roof materials, 94.8% permanent walls material and 95.2% permanent floor material (2014 Census). • 7.9% live in semi-permanent dwelling units and 0.1% in temporary dwelling units • 82.1% (340,429) of the households do not live in decent dwellings (2014 census)
3. Governance	
Planning	• KCCA has a Physical Development Plan • KCCA has 5 year Strategic Plan 2014/115 – 2019/20

	• KCCA has a Climate Change Action 2016 - to ensure the City's development path takes a low emission approach, builds resilience and maximizes the co-benefits of efficiency, economic diversity and human wellbeing • Kampala Institutional and Infrastructure Development Projects (KIIDP) 2015-2020
Financing	• Climate change action strategy - mainstreams climate change actions in KCCA's service delivery
Participation	• Climate change strategy development was highly participatory (KCCA, public, NGO, private sector, and community participation)
Administrative units assigned to address climate change and disaster risk management	• The Departments responsible for Strategy Management, Physical Planning, Disaster Management and Environment KCCA are spear heading climate change
Willingness of urban authorities (leadership) to address climate change	• The Kampala Climate Change Action 2016 is KCCA's roadmap to ensure the city's development path takes a low emission approach, builds resilience and maximizes the co-benefits of efficiency, economic diversity and human wellbeing. • The Climate Change Strategy builds on the ambition of the Strategic Plan 2014 – 2019 to transforming Kampala City into an attractive, vibrant and sustainable world class City. • The climate change strategy also provides a framework for KCCA to contribute to the national and international ambitions on climate change response. • By taking bold steps to mainstream climate change actions in its own services, KCCA is demonstrating its leadership at the local, national and regional level of what needs to be done to combat the global phenomena. • KCCA is implementing a the Kampala Climate change project – supported by EU •
4. Socio-economic characteristics	
Population/demographics	• Population 1,507,114 (2014 Census) • 724,326 male 782,754 female), • 41.3% below 18 years – high dependency burden, • Annual population growth rate of 4.03%, (2014 census)
Population density	• 8,646.9 People per sq.km
Urban poverty	• 1.1% (4,727) of the households depend on subsistence agriculture as a means of livelihood • 14.4% (59,495) households members aged 5 years and above consume less than two meals in a day (2014 census) • Although unemployment rate reduced from 24.8% in 2013 to 21.0% in 2017 in Kampala, the city has the highest unemployment rate in Uganda - UNHS (UBOS, 2016/17) • 17% of those employed are in elementary occupations next to 46.1% employed in service and sales
Per Capita GDP	• Major business and industrial hub of the country contributing over 60% of the country's GDP
5. Environment and ecosystems	
Ecosystems	• Encroachment of developments such as buildings and cultivation in the drainage and wetland areas e.g. Nakivubo, Lubigi, Nalukolongo, Kinawataka, Nyanama-Walufumbe and Kansanga • Blocked drainage culverts by garbage and poor maintenance of the drains

	• Damage to property and infrastructure - buildings, roads and in some cases people have drowned and lost lives • Contamination of drinking water - springs, wells and leaking pipes resulting into outbreaks of diseases such as cholera, dysentery, typhoid and diarrhoea mainly in the densely, populated and poorly planned settlements • Stagnant water is breeding ground for mosquitoes
Natural assets	• Wetlands • Lake Victoria • Green spaces
Climate change response actions	• KCCA already has a Climate Change Action Plan • EU is supporting KCCA to implement the Climate Change Action Plan - Project entitled: "Kampala climate Change Action Strategy: Developing and sharing the low carbon and climate resilient Kampala" • Wetland restoration and ecosystem management • Flood management • Drainage and waste water management • Investment in green energy technologies • Green transport/resilience transport, improving mobility. • Green tourism • Water security and water resource management

7.2.11 Kiruhura Town Council



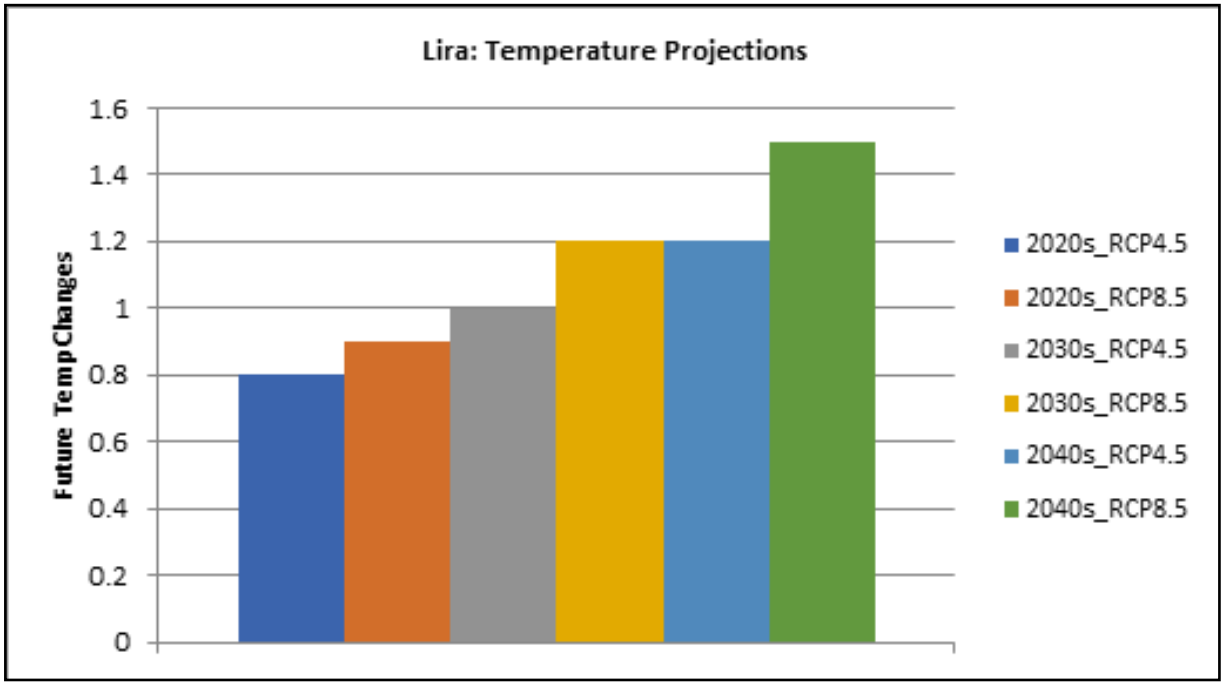


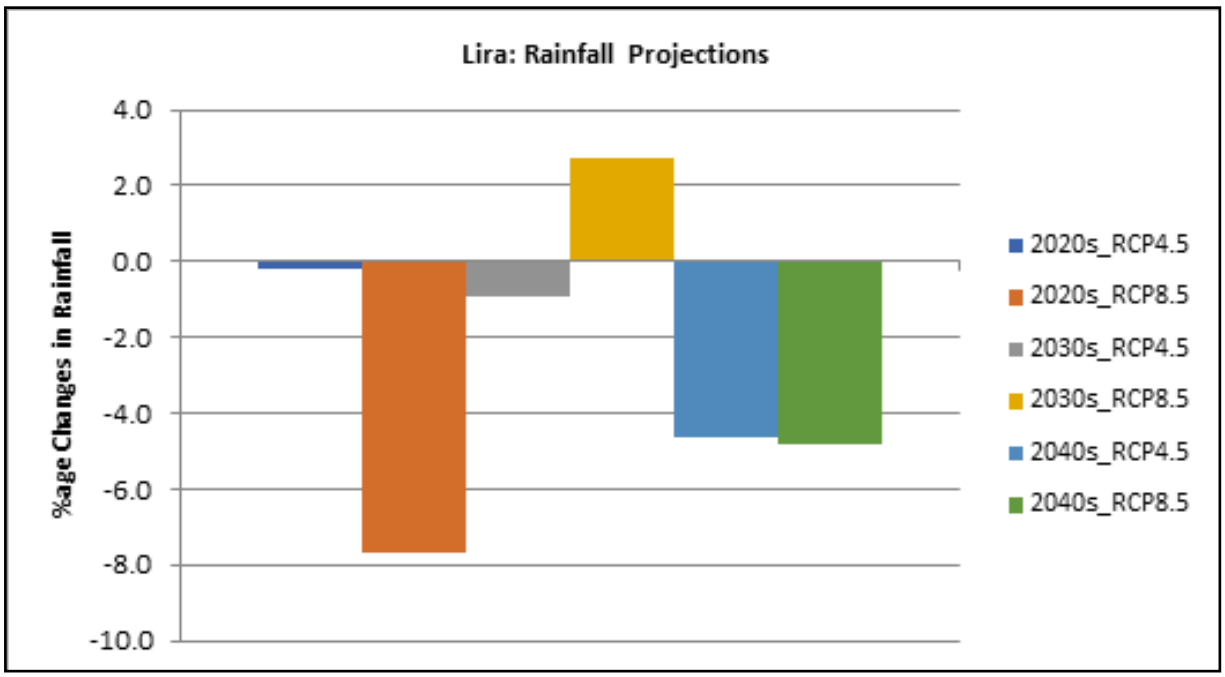
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 21.3^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.2^{o}C under RCP 4.5 and 1.3^{o}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 987mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by +0.3% under RCP 4.5 and +2.1% under RCP 8.5

Extreme weather events	• Extreme temperatures and heat waves • Very severe droughts and long dry spells - reduced crop production (maize, cassava, beans) - food insecurity • Drying water sources leading to water stress and water shortage • Extreme rainfall - results into flooding and erosion • Flooding is also precipitated by the high environmental degradation - charcoal burning (deforestation) and overgrazing
2. Infrastructure	
Water supply	• Water scarcity and water quality is a very big major problem in the TC and District as a whole. • The main sources of water are valley dams/tanks and boreholes. • Some households and institutions have water harvesting tanks • The valley dams and tanks dry up during the dry seasons • Piped water for the TC is from Kakyera, and supplies 40% of the town, • Some boreholes dry up during the dry spells • Competition for water between human and animals in the valley dams/tanks - water is not clean and water borne diseases are common. • There is a high potential for water harvesting using of solar powered water pumps.
Energy/electricity	• Electricity serves only 20% - not reliable can take 1 – 2 weeks without it • Solar for lighting is common – 70% of households • Use of kerosene for lighting is reducing • Diesel generators are used for cooling milk • Charcoal and firewood dominate for energy for cooking • Low use of LPG and biogas • High potential for biogas given that many households have cattle
Sanitation and sewerage	• No sewer systems: • Pit latrines dominant; a few septic tanks.
Solid waste management	• Have a disposal site, where open dumping is practiced • No plan solid waste management strategy • Plastic waste is a big challenge • Relatively a clean town
Storm water drainage	• Drainage system is very poor • Silting of drains, causing flooding • Silting of valley dams/tanks
Transport	• Only the main road is paved • Unpaved roads are washed away by rains and floods
Housing	No data
3. Governance	
Planning	• 5 year development plan 2015/16 – 2019/20 • Structure Plan 2008-2018 - compliance is low
Financing	• Not yet done
4. Socio-economic characteristics	
Population/demographics	• Total population 5,615, (2014 census)
Population density	No data

Urban poverty/economy	• Livestock keeping is a major economic activity, but dry spells affect this economic activity – lack of water and pasture • Food insecurity is high - low crop production - low engagement in cropping, less rainfall and dry spells • High dependency on food from outside the district – Mbarara, Ibanda – high food prices and poor households cannot afford.
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Encroachment on wetlands • Charcoal burning and deforestation • Bush burning • Overgrazing • Tree planting is limited
Natural assets	
Climate change response priorities	• Developing a stand alone climate change strategy/plan • Water security – waster harvesting/storage • Energy access and security – renewables: solar, biogas, energy saving cook stoves • Addressing land degradation: afforestation and tee planting, wetland restoration • Develop a climate proofed physical development plan • Sustainable solid waste management

7.2.12 Lira Municipality





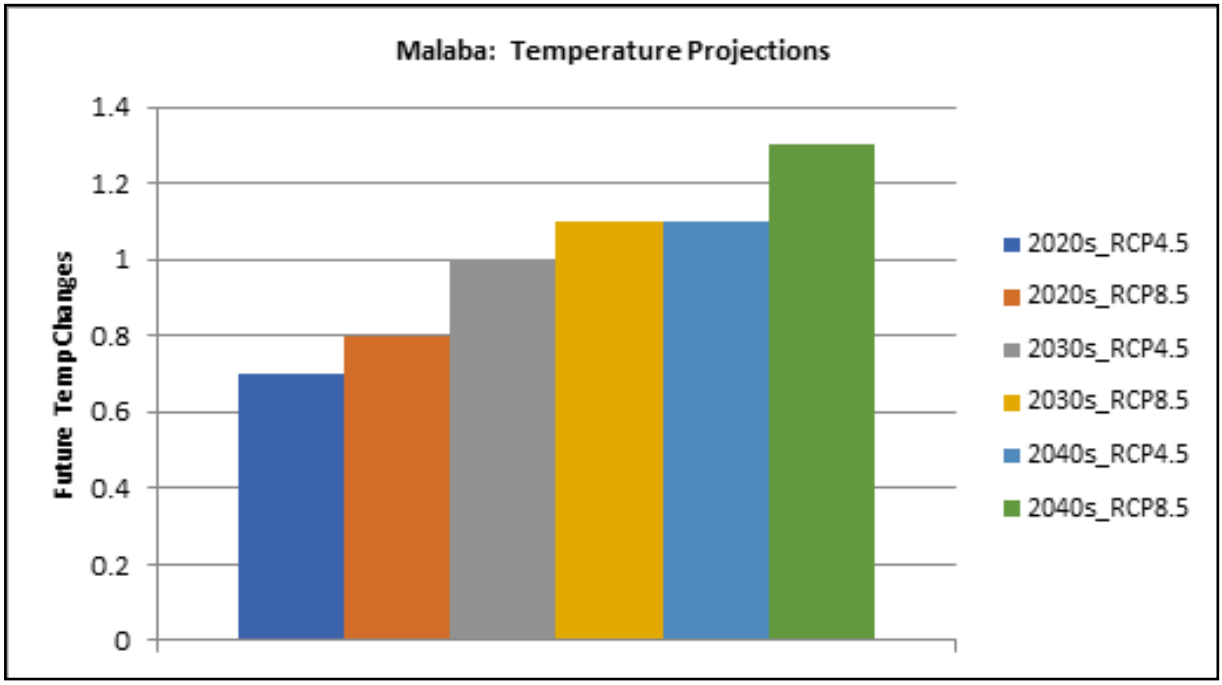
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 23.1^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.2^{o}C under RCP 4.5 and 1.5^{o}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1345mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -4.6 ^{o}C under RCP 4.5 and -4.8^{o}C under RCP 8.5 scenario

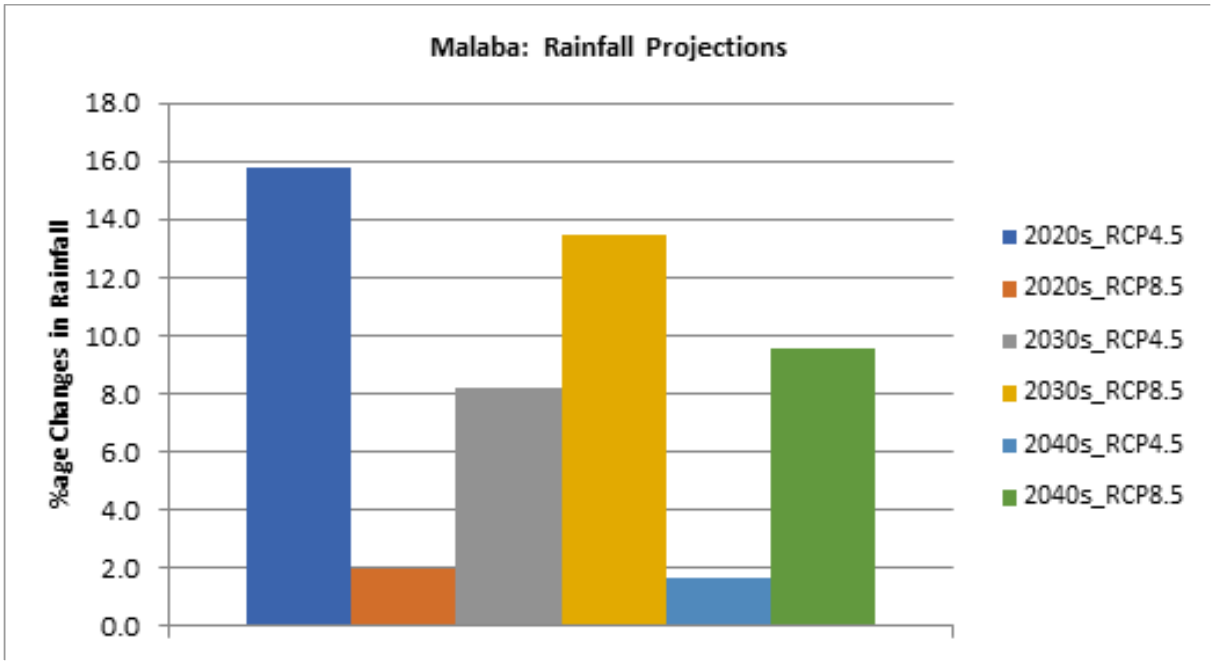
Extreme weather events	• Extreme temperatures and heat waves • Unpredictable rainy seasons • Droughts • Flooding due to heavy rainfall and increased pavements and concretes without soft surfaces which increasing runoff and siltation of drains
2. Infrastructure	
Water supply	• 17,362 (68.8%) of the households have access to piped water while 12.2% use boreholes (2014 Census) • Piped waster is supplied by NWSC – source is Kacwan - Lake Kyoga • Water - supply is reliable • Boreholes and protected springs are used as water source – although discouraged for drinking • Limited rainwater harvesting in the Municipality
Energy/electricity	• 9,632 (38.1%) of the households have access to electricity while 23.9% use kerosene/tadooba for lighting • The outskirts of town have no electricity • Charcoal and firewood are widely used for cooking (80%) • Solar used by some households • Solar lighting on all USMID supported roads
Sanitation and sewerage	• NWSC operates a central sewer system, but is mainly in the CBD • Two sewerage lagoons at Ojwina and Railways • Pit latrines are used at the outskirts - Kakoge, Central Park and Ireda Shamba • Septic tanks are also used • 153 (0.6%) households did not have sanitation facility (2014 census)
Solid waste management	• Has CDM solid waste compositing facility in Aler Ngetta Sub County • Sorting is done to remove plastics, polythene, e-waste and glasses at the composting site - no mechanism in place to recycle these, and this poses a danger to the environment since they are just buried • Open dumping is common - blocks drains leading to flooding • Liquid waste from petrol stations, industries, garages and medical waste are not managed – health hazard • 15,900 (63.0%) properly disposed off solid waste (2014 Census).
Storm water drainage	• Drainage on all USMID roads
Transport	• Total of 250 km of motorable roads, 90 more km are planned to be opened • Of the 250km of motorable roads, 45km are paved including those under UNRA (15km) • 6.8 km of roads earmarked for paving under USMID support, 3.8 completed - OyiteOjok, Emitimana, Ambobha, Awangenol, Aduku and Maruziro. 3km are to be completed - Obote Avenue, Rotale, Oyam, Aromale, Soroti and Kwania roads
Housing	• 22,797 (90.3%) of the households live in dwelling units constructed using permanent roof materials, 68% permanent wall material and 73.9% permanent floor material, 29.5% semi-permanent dwelling and 8.4% temporary dwelling units and 89.6% of the households do not live in decent dwellings (2014 census).

3. Governance	
Planning	• 5-year Municipal Development Plan 2015/16 – 2019/21 • Physical Development Plan 2016 – 2026 • Layout plans have been prepared for the entire Municipal area • Municipal Development Strategy 2016 – 2040 – USMID support • Solid Waste Management strategy 2016/17-2020/21 - USMID support • Drainage Master Plan – USMID support
Financing	• Budget is sensitive to climate change issues - tree planting, regeneration and solid waste management are catered for
Participation	• International Lifeline Fund engages in energy saving stoves manufacture in Lira and clean water and sanitation (WASH) in Apach through construction of boreholes. • They make energy saving stoves for both charcoal and fire-wood use branded Eco-smart and Okelo Kuc in different sizes and prices for both household and institutional use like prisons and schools. .
Willingness of urban authorities (leader-ship) to address climate change	• Structure plan provides a 20-metre buffer zone from the wetlands – but developments don't respect that • Temporal building have been removed along Obote Avenue, Juba and Soroti road reserves to ensure regeneration by tree planting • Tree planting - Mayor's garden, lorry park and along road reserves like Kampala road both for beautification and ad-aptation • Public open space opposite Lira main market to be devel-oped – USMID support
4. Socio-economic characteristics	
Population/demographics	• Total population 99,511, (47,923male and 51,585 fe-male) • 46.7% below 18 years meaning a high dependency burden (2014 census). • At 3.5% annual growth rate, the population is projected to be 151,924 in 2020
Population density	No data
Urban poverty	• Municipality mainly thrives on business both retail and wholesale • Institutions like banks, hotel industry is another source of income • Transportation -bus and lorry parks is another notable in-dustry • Unemployment and under employment
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems and environment	• Deforestation and land degradation - charcoal production is leading to overcutting of trees and land degradation • Encroachment on wetlands like Okele swamp • Bush burning in wetlands during the dry season is common • Solid waste management - no sorting of waste, open dump-ing and blockage of drains

	• Indiscriminate burning of tyres and polythene • Liquid waste from petrol stations, industries and medical waste • Encroachment on the malaria drains • Silting from gravel roads into the wetlands - destroying the ecosystem services
Natural assets	• Rocks, fertile soil, forest, sand, swamps –(5 year Development Plan)
Climate change response priorities	• Develop a stand-alone Municipal climate change strategy/ plan. • Flood management, storm water management • Sustainable/green energy to increase energy security, improved cook stoves • Water storage and rainwater harvesting • Solid waste management, especially recovery and recycling, waste to energy • Urban agriculture

7.2.13 Malaba Town Council



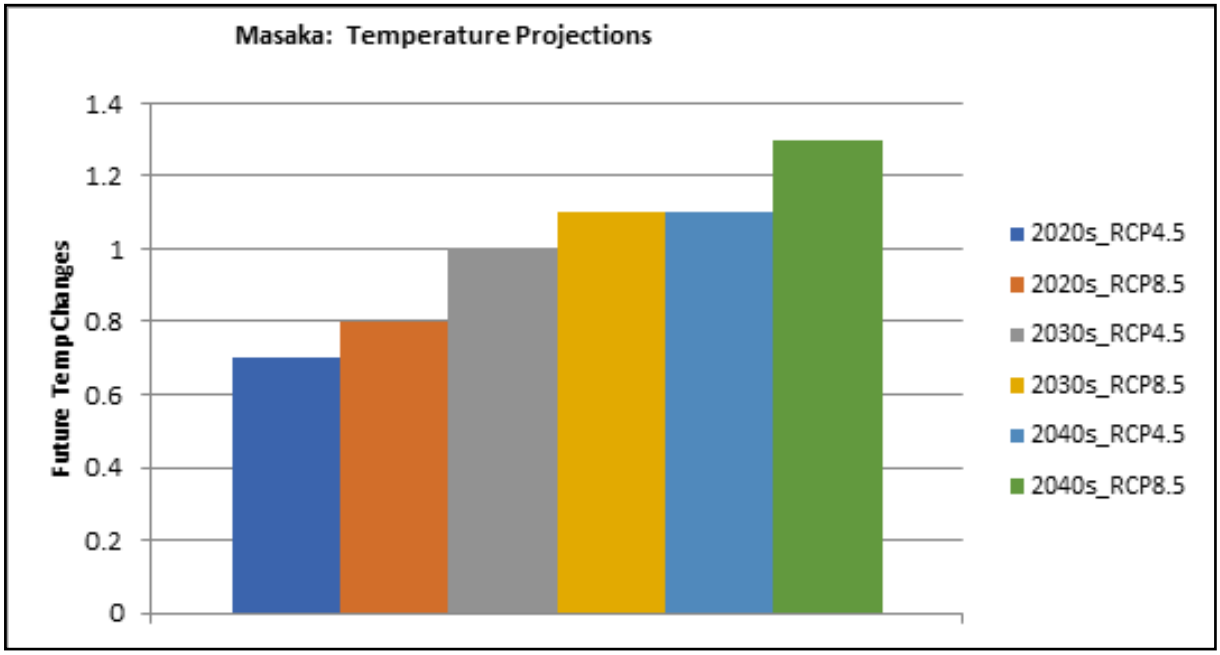


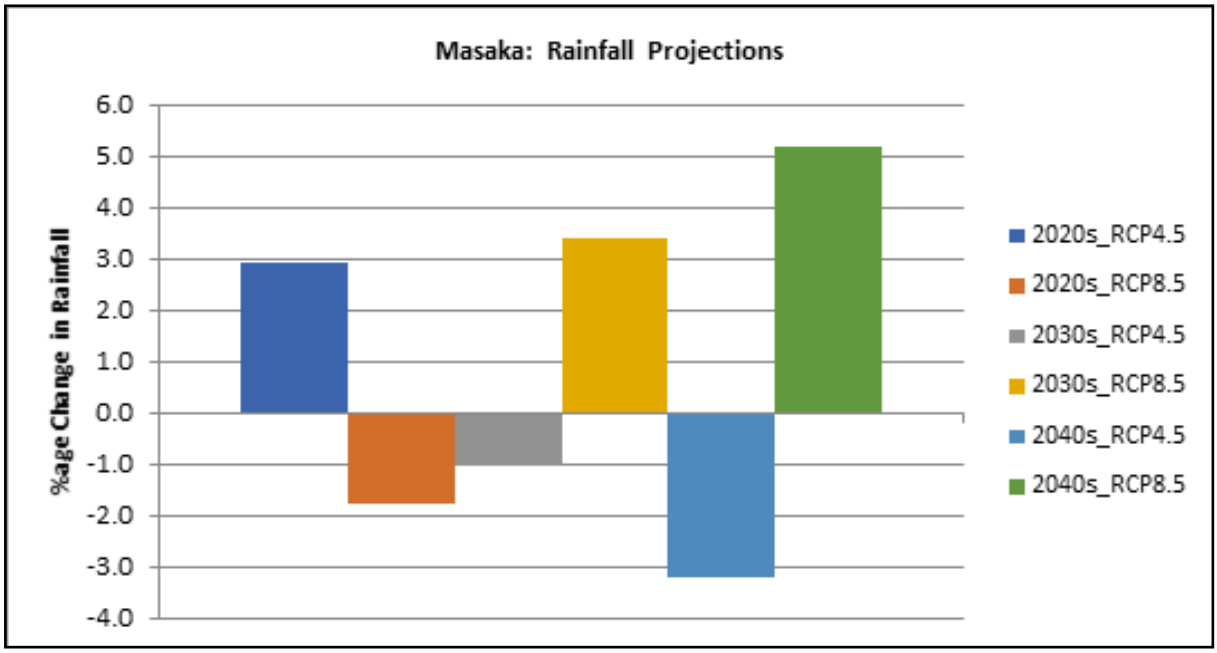
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 23^{0}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.1^{0}C under RCP 4.5 and 1.3 ^{0}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1306mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by +1.7% under RCP 4.5 and +9.6% under RCP 8.5 scenario

Extreme weather events	• Extreme temperatures and heat waves • Droughts - drying of wells and boreholes in Amagoro • Flooding – Malaba is a boggy area and families usually re-locate in areas like Finya B cell in Asinge ward during the rainy seasons
2. Infrastructure	
Water supply	• NWSC supplies piped water – source is River Malaba • Piped water coverage 40%: water is always dirty • Protected and unprotected wells and springs are also used • Shadoofs are also used
Energy/electricity	• Electricity covers only about 20%, and is reliable, used mainly for lighting. • Kerosene/tadooba commonly used for lighting • Rechargeable lamps are also used particularly outside the CBD • Use of solar energy is too minimal • Wood fuel and charcoal are widely used for cooking. The charcoal mainly comes from Kapchwora, Mbale and Tororo
Sanitation and sewerage	• No sewer system • Pit latrines dominate - high water table, Pit latrines are hardly 2 feet deep • Septic tanks used by a few households – high water table leading to septic tanks overflows • Flying toilets (polythene) are also common- thrown into drainage channels • Incidents of typhoid and dysentery reported - contamination of water sources with faecal matter
Solid waste management	• Malaba TC collects waste from central places like the market • Garbage volume increases on market days - Wednesday and Saturday • Indiscriminate dumping - clogging the drainage channels • Waste end up in River Malaba during the rainy season • Planned site for solid waste disposal in the structure plan was boggy – and was abandoned • Currently waste is dumped on an individual's land at a monthly fee of UGS 600,000 • Dumping site close to the community - Complaints due to foul smell
Storm water drainage	• No proper drainage on roads. Where the drainage channels exist they have been poorly maintained – Drainage on the main road is blocked by waste or siltation • Water over flow on the carriage way during rainy seasons • Drainage master plan was prepared in 2007 but has never been implemented due to lack of funds
Transport	• Only the main road is paved • Many roads were planned in the structure and detailed plans – not opened due to lack of funds for compensation and development of the roads
Housing	• No data
3. Governance	
Planning	• Structure Plan 2008 – 2018 - developed with UN-Habitat support • 5-year Development Plan 2015/16 – 2019/20

Financing	• 2016-2007 budget - plant 10,000 trees and beautify the Town - trees to be planted on all roads and the buffer zone
4. Socio-economic characteristics	
Population/demographics	• Population is 24,000, (46.9% male and 53.1% female), (5 year Development Plan)
Population density	No data
Urban poverty/economy	• High urban poverty • Daily market • Weekly market on Wednesday and Saturday • Taxi park, although there is no gazetted area for the park • Trailer parking yard • Trading license • Property rates • Hotels • Land dues/property rates • Poor do not have stale sources of income
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Along River Malaba, it is planned buffer zone of 100 metres to be planted with trees. However this has not happed due to lack of funds • Open spaces were planned in places like Namagoro and Asinge B cells, but the land has never been purchased from individual owners hindering their development • Reduction in water table and degradation of the water catchment areas has led to drying of some wells and bore-holes for instance Akelele well in Amagoro • The river bed is shallow due to silting • Dumping of waste in the river channel - garbage from the town council ends into the river whenever it rains • Pollution of water due to poor sanitation, poor solid waste management practices and runoff • Trees and natural vegetation are increasingly being de-stroyed due to human activities particularly agriculture
Natural assets	• River Malaba
Climate change response priorities	• Water catchment protection – Malaba river banks • Ecosystem restoration and management • Solid waste management (green strategies) • Trans boundary natural resource management – boarder with Kenya • Sustainable energy/renewables • Water security (quantity and quality). • Sanitation improvement

7.2.14 Masaka Municipality



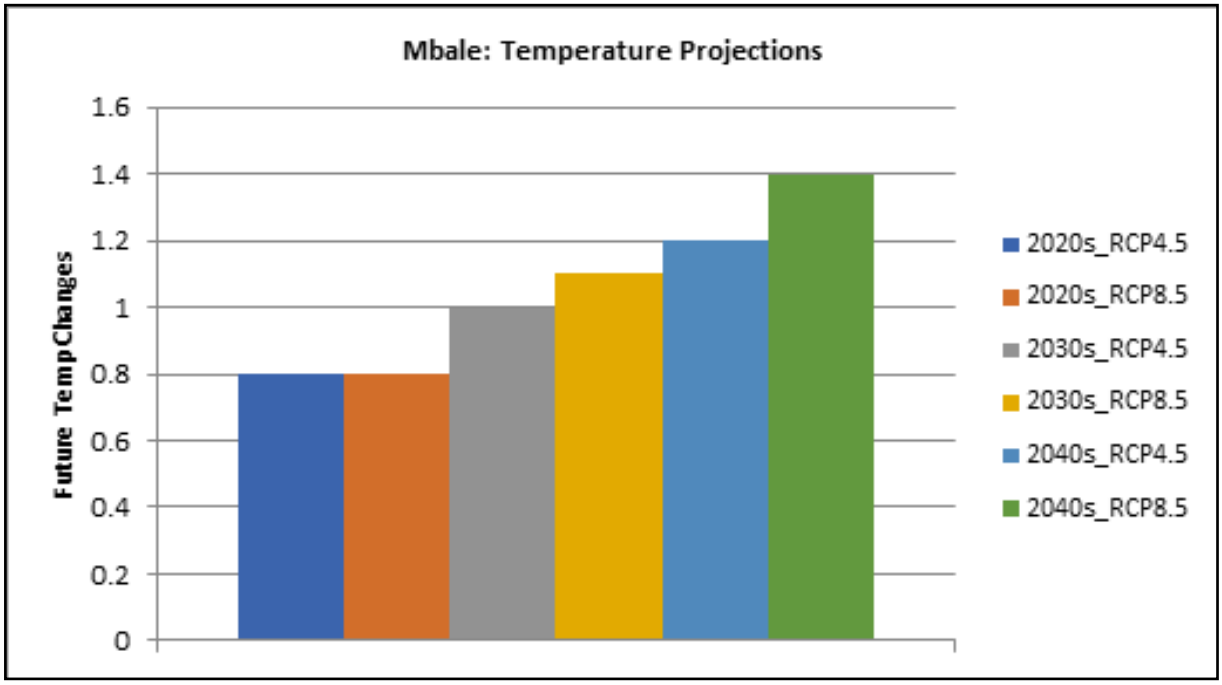


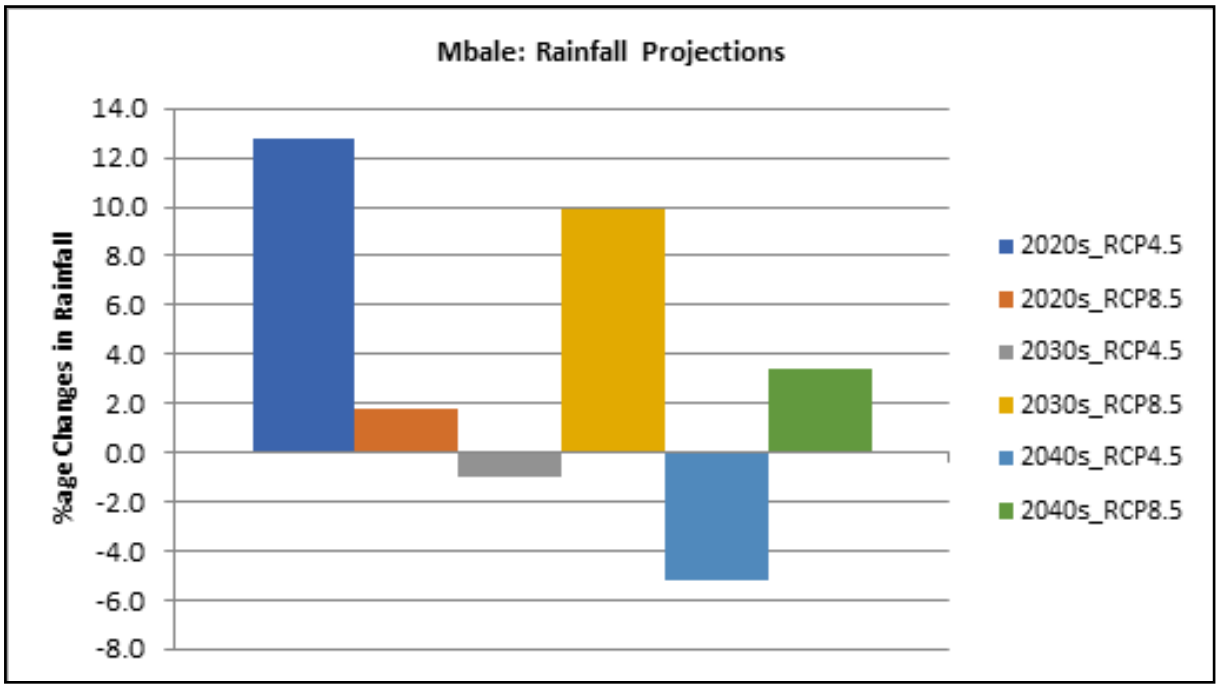
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 20.9^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.1^{o}C under RCP 4.5 and 1.3^{o}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1061mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -3.2% under RCP 4.5 and +5.2% under RCP 8.5 scenario

Extreme weather events	• Extreme rainfall, unreliable rainfall patterns/seasons • Flooding - especially the Nyendo area, mainly attributabled to wetland encroachment and blockage of drainage channels and poor solid waste management • Droughts and dry spells on the increase. Masaka is near the cattle corridor, which is prone to dry conditions. Water availability is constrained during droughts • Droughts affect vegetation and beautification programmes • Droughts affects agricultural production in the hinterland hence food shortage and rising food prices. Poor households face food insecurity
2. Infrastructure	
Water supply	• 24,72 (86.8%) of the households have access to piped water while 2.1% used borehole (2014 Census) • Piped waater supplied by NWSC. Sources is Nabajjuzi and Nakayiba wetlands • Water levels tend to reduce during the dry seasons and • Water also becomes dirty in wet season • Boreholes and shallow wells - dry up during dry conditions • Shallow wells are affected by flooding – poor water quality
Energy/electricity	• 19,603 (68.8%) households accessed electricity for lighting while 10.9% used kerose/tadooba • Electricity supply is not reliable: load shedding is frequent and thermal generators widely used by businesses in case of load shedding, • Use of solar for lighting in homes and institutions is increasing - sale of solar equipment is very visible in the town • Charcoal/wood fuel is main source of energy for cooking • Limited use of energy cook stoves • Charcoal briquettes are being made and used on a limited scale
Sanitation and sewerage	• Central system by NWSC is available but limited coverage. • Pit latrines dominate • Poor health resulting from poor sanitation and hygiene • 70 (0.2%) of the households had no sanitation facility
Solid waste management	• Main method is collection and disposal - coverage is about 60% • Municipality is renting a dumping site – Bwala dumping site. There is a proposed dumping site (20 acres at Bulanda outside the Municipality) but this is not yet worked on • Dumping in drainage channels causes flooding in the town • 22,137 (77.6%) of the households disposed off solid waste properly (2014 census).
Storm water drainage	• Poor drainage – frequent flooding in Nyendo area • Drainage channels clogged by solid waste and silting • Encroachment and blockage of natural drains, and wetlands • USMID support – designing and implementation of the municipal drainage master plan
Transport	• USMID support to work on raods - Yellow Knife road, Buddu Street and Kabula drainage - Phase II Edward Avenue, Jethabai Street, Ssese Street drainage • Opening of access roads in divisions (5 year Development Plan)

Housing	• 28,284 (99.3%) households live in dwelling units constructed using permanent roof materials, 95.9% permanent wall material and 91.4% permanent floor material, 8.9%% in semi-permanent dwelling units, 0.7% temporary and 86.3% do not live in decent dwellings
3. Governance	
Planning	• Physical Development Plan 2015-2025 • 5-year Development Plan 2015/16 – 2019/20 • Municipal Development Strategy 2016-2040 - USMID support • Solid Waste Management strategy - USMID support • Drainage Master Plan – USMID support • Environmental Action Plan 2013/14 – 2017/18
Financing	• Very small budget for the environment sector in the Municipality
Willingness of urban authorities (leadership) to address climate change	• Willing
4. Socio-economic characteristics	
Population/demographics	• Total population 103,293, (51,643 male, 51,650 female) • Annual population growth rate 3.6% (2014 census)
Population density	No data
Urban poverty/economy	• Agriculture • Hotels and restaurants • Markets • Industry- processing and metal fabrications • Shops • Tourism (limited) • Transport – buses, taxi, boda-boda • Poor households face food insecurity due to dry and low yields • Inability to meet the basic needs and services in the family such as food, clothing, shelter and medical care
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Wetland coverage - Nakayiba and Nabajjuzi wetland which is also Ramsar site • Encroachment on wetland, and green/ open space • Droughts failing vegetation and beautification programmes
Natural assets	
Climate change response priorities	• Development of a stand alone climate change strategy/plan • Green energy investments, energy access/security, energy saving cook stoves • Water security, water resource management • Green tourism • Flood management • Ecosystem restoration and management. • Green solid waste management practices

7.2.15 Mbale Municipality





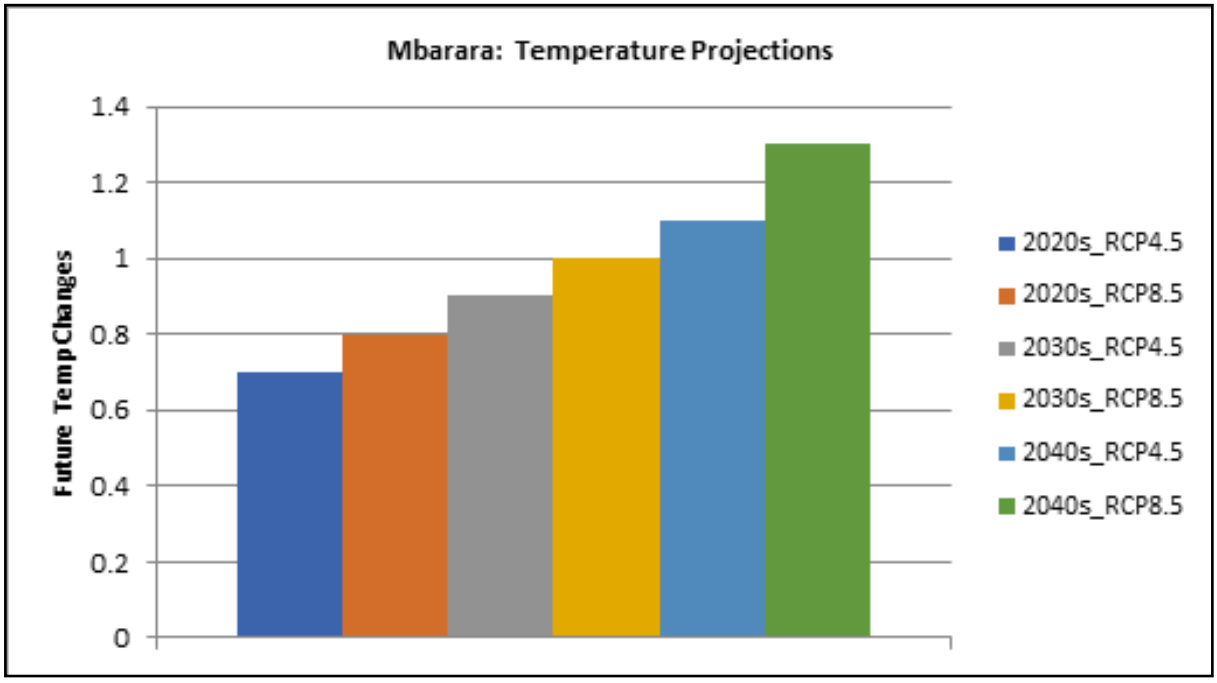
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 22.6^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.2^{o}C under RCP 4.5 and 1.4^{o}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1,508mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -5.2% under RCP 4.5 and +3.4% under RCP 8.5 scenario

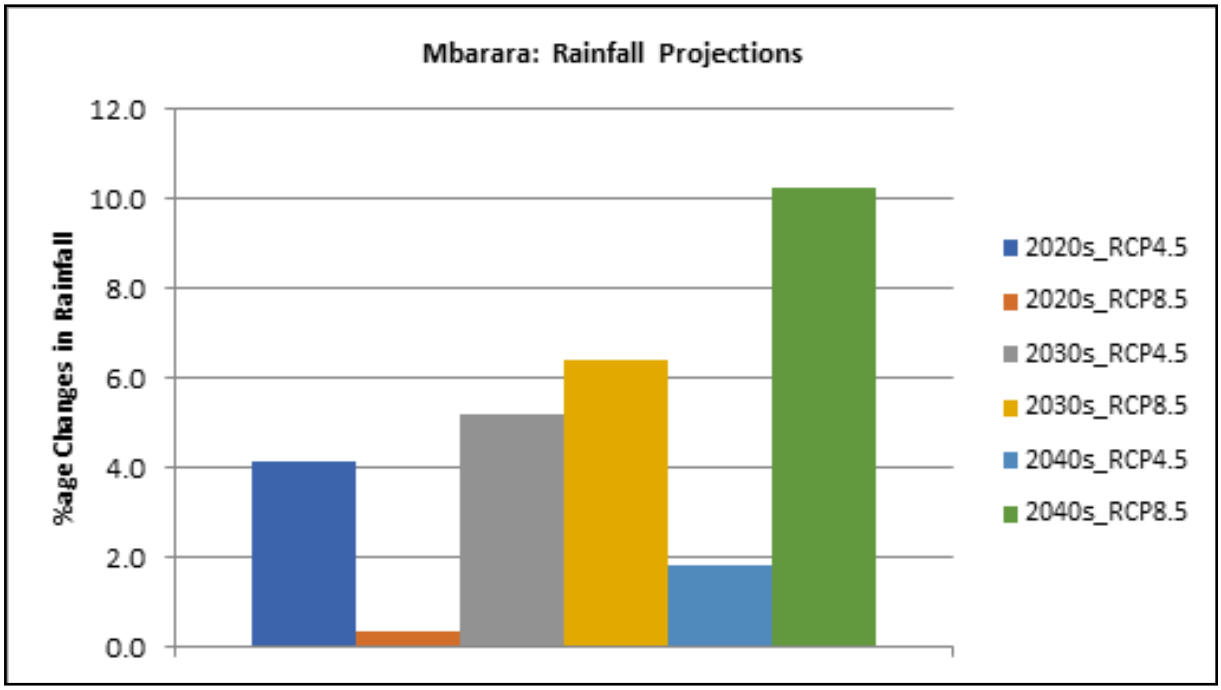
Extreme weather events	• Extreme temperatures and heat waves: December to March are hotter than normal • Extreme rainfall - unpredictable rains and the seasons • Flooding occurrence - Namatala, Maluku, Adra, KCB, Namakwekwe and Cathedral avenues areas • Droughts - dust causing visibility problems and reduction of green vegetation • Droughts and floods affect agriculture – food insecurity
2. Infrastructure	
Water supply	• 21,504 (89.3%) access piped water while 1.3% use boreholes • Piped water by NWSC - affordability is a problem for many households • River Namatala is source of for piped water by NWSC • Water source is highly contaminated due to continuous breakdown of the sewer system and other households who directly connect to the river. • Boreholes and protected springs are other water sources. • Water provided under the Participatory Slum Upgrading Programme (PSUP) interventions is for paying - the poor cannot afford • Rainwater harvesting is increasing - NEMA provided tanks to Namatala Health Centre and Wambogo and Doko schools
Energy/electricity	• 13,238 (54.9%) have access to electricity for lighting while 18.6% use kerosene/tadooba • High cost of electricity. Illegal electricity connection (looping) is a common practice • Charcoal and firewood are most used for cooking • A few use biogas and LPG for cooking • Solar business has not picked up very well – high initial cost • Solar street lighting is yet to be done on four roads under USMID support - Republic, Pallisa, Mugisu Hill and Nabuyonga Rise
Sanitation and sewerage	• Central sewer system operated by NWSC - covers 30% especially in the CBD. • Sewer system is absolute and was constructed in the colonial era for small number of population as opposed to the big population currently. • Septic tanks and pit latrines are used in the outskirts • The use of mobile/flying toilets is also common • 182 (0.8%) households did not have sanitation facility (2014 census) • Cholera outbreak in slum areas - Namatala, Busamoga due to poor hygiene and drainage
Solid waste management	• 150 tonnes generated per day of which about 50% is collected • Has a CDM solid waste composting facility. But no adequate equipment to collect all the garbage • Indiscriminate dumping is common • Private sector waste collection services are limited to a few rich households • Backyard gardens and pits are used in senior quarters • Medical waste from government health centres is collected by Green Label and transported to Iganga for incineration - Mbale main hospital also has a project on incineration • 17,157 (71.2%) households disposed off solid waste properly (2014 Census)

Storm water drainage	• Appropriate Drainage provided on USMID roads • It is common to find the drainage silted with growing vegetation • The malaria drains are interfered with through encroachment and diversion of water by those growing rice • Land owners also block the road drainage • Drainage Master Plan prepared under USMID support but no funds to implement it
Transport	• 121 km of road out of which 45 km are paved. Paved roads are worn out and patches are all over • 3.1km has been tarmacked – USMID support • Unpaved roads do not last long due to poor drainage
Housing	• 23,839 (98.9%) households live in dwelling units constructed using permanent roof materials, 71.3% permanent wall material, 71.7% permanent floor material, 33.6 % semi-permanent dwellings, 0.8% temporary and 87.4 % do not live in decent dwellings
3. Governance	
Planning	• Physical Development Plan 2016 – 2026 • 5 – year Development Plan 2010/11 – 2014/15. A new Development Plan 2015/16 – 2019/20 is being developed • Municipal Environment Action Plan expired in 2016 • Solid Waste Management strategy exists - USMID support • Municipal Development Strategy exists – USMID support
Financing	• Minimal consideration of climate change in the budget - no funding is received from the centre for environmental issues, municipal allocations are also low, if at all it is provided • However, projects like new road or school upgrading - some funds are allocated for tree planting
Willingness of urban authorities (leadership) to address climate change	• Keep Mbale Municipality clean campaign by the Municipal Council and other stakeholders like universities and banks are undertaken to improve sanitation • Tree planting is encouraged - development approval, plots have to be developed up to 70% and 30% should be left as soft surface - other trees are planted on roads reserves, health centres and schools • New plan is advocating for new green spaces in neighbourhoods - woodlots encouraged
4. Socio-economic characteristics	
Population/demographics	• Population 92,863 (44,334male and 48,518 female), • 46.2% is below 18 meaning high dependency burden (2014 census)
Population density	No data
Urban poverty/economy	• Urban poor increasing, especially the youth • Mbale is a vibrant and enterprising municipality - strategic location as a regional hub • Low yields in agricultural production as farmers could not rightly predict the season and this was compounded by the outbreak of armyworms and beans rotting in floods • Food grains are also exported to Kenya and South Sudan hiking local prices – hiking prices and unaffordable by the poor • Cholera outbreak in slum areas - Namatala, Busamoga due to poor hygiene and drainage – compounding the meagre resources of the poor

Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Deforestation for charcoal production • Wetland degradation - Namatala wetland, • Deteriorating environmental quality – clearing trees, open spaces and encroachment on river banks • The Municipality together with Ministry of Water and Environment have demarcated 13 km of wetland to be conserved. While this is still work in progress, the challenge is that some parts are heavily developed.
Natural assets	• River Namatala/wetland
Climate change response priorities	• Develop standalone climate change strategy/action plan • Climate proof transport infrastructure – roads, bridges and drainage channels • Green energy/energy security: solar street lighting, solar in homes and institutions, biogas and LPG for cooking, improved cook stoves. • Ecosystem restoration and management, greening the city. • Flood management.

7.2.16 Mbarara Municipality





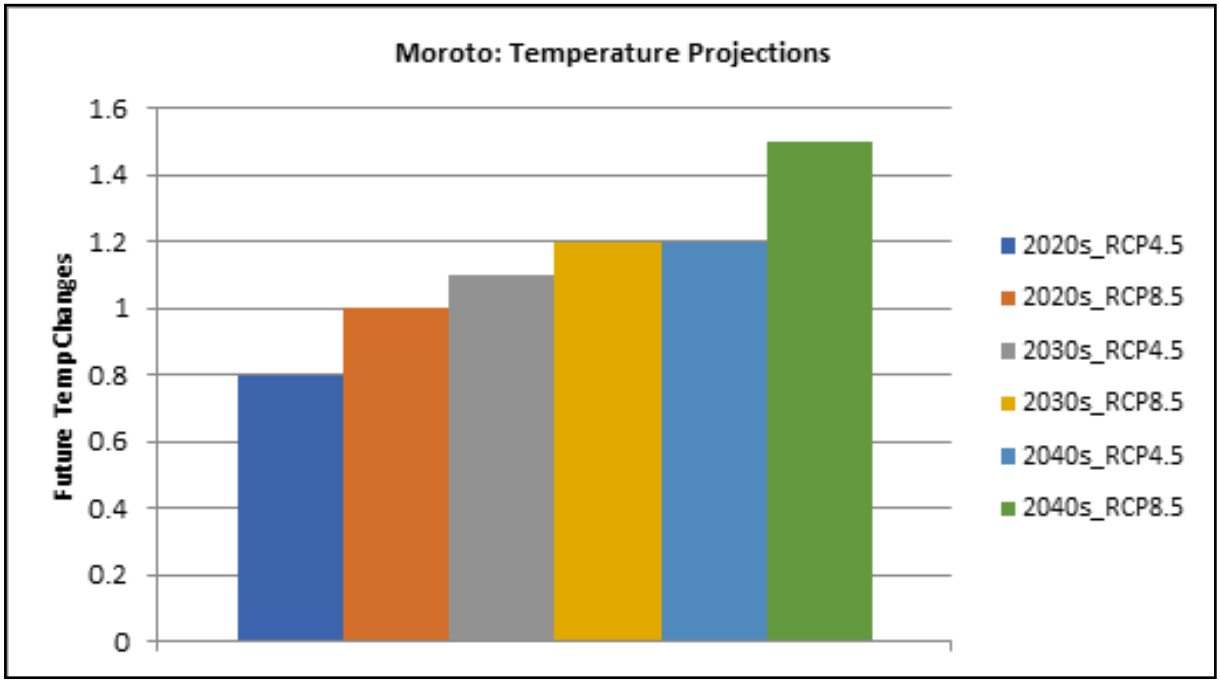
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 20.4°C
Temperature-projected change by 2040	• The annual temperature will increase by 1.1°C under RCP 4.5 and 1.3°C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1,508mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by +1.8% under RCP 4.5 and +10.3% under RCP 8.5 scenario

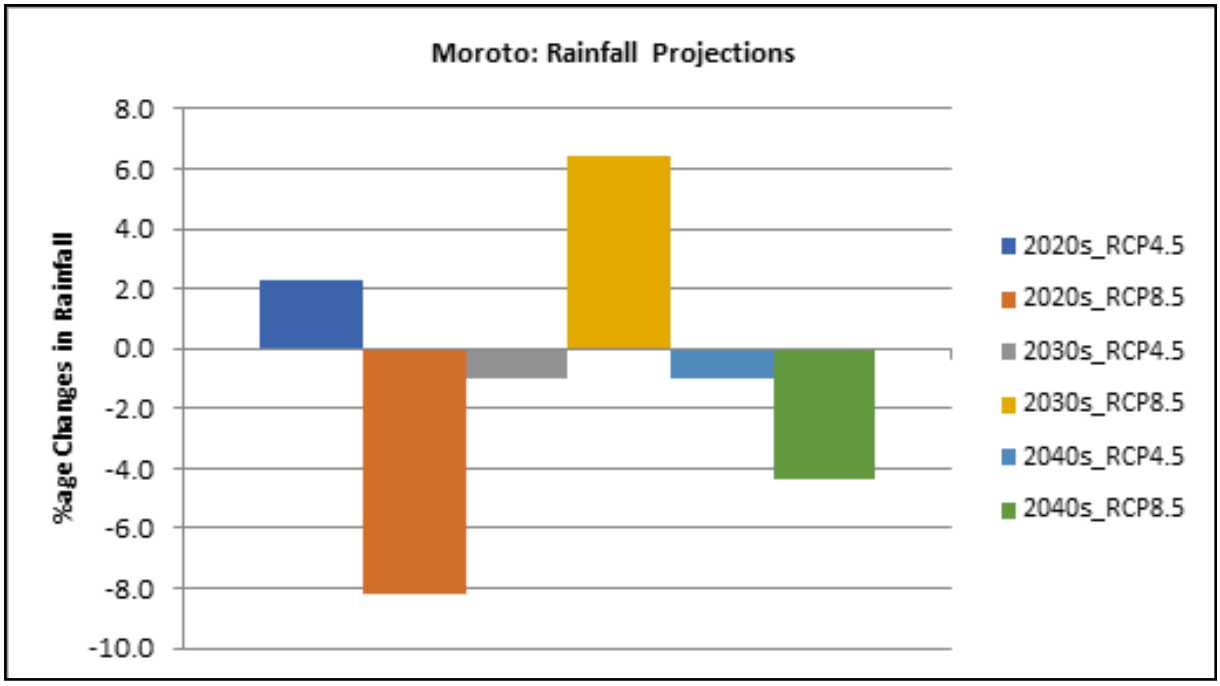
Extreme weather events	• Extreme temperatures and heat waves • Droughts and dry spells: affect crop and livestock production and water availability – • Extreme rainfall and storms • Flooding - related to inadequate drainage systems and encroachment of on wetlands, open spaces and drainage channels by developers.
2. Infrastructure	
Water supply	• 78.3% of households have access to safe water (5 year Development Plan) • Piped water supply by NWSC – coverage 47.5%: • Municipality is experiencing water stress. • Source of water is River Rwizi. The volume of water in the river has been reducing in the last 10 years due to reduced rainfall, droughts degradation of Rwizi catchment (both up stream and down stream degradation) i.e. deforestation and land degradation, construction along river banks, sand mining, brick making, diversion of water for brick making • 1,844 (3.5%) households use boreholes • Other sources: protected springs and unprotected water sources that are highly vulnerable to droughts, floods and contamination • Municipality seeks to construct, operate and maintain appropriate community water supply systems in all areas, prioritising the un-served areas. • Promoting and scaling up rainwater harvesting at household, public institutions and community level
Energy/electricity	• Electricity coverage is 70%, mainly for lighting - load shedding is experienced • 57% of the households use Electricity for lighting (5 year Development Plan) • 9,645 (18.4%) households used kerosene/tadooba for lighting • Solar lighting on the increase in homes and institutions • Charcoal and firewood widely used for cooking • LPG and biogas are used on limited scale
Sanitation and sewerage	• Central sewer system by NWSC, covers small area mainly the CBD • Use of pit latrines and septic tanks • 348 (0.7%) households had no access to a toilet facility • Health sector seeks to improving hygiene and sanitation through construction of pit latrines
Solid waste management	• Main method is collection and disposal: 70-80% coverage • Has a CDM solid waste composting facility - segregation of biodegradable and then composting • The other waste is dumped at the landfill – Rwenkombe landfill • Illegal disposal and dumping remains a challenge • 29,352 (56.1 %) households disposed off solid waste properly (2014 Census).
Storm water drainage	• Flooding is a challenge due to poor drainage infrastructure. • Developed a Municipal drainage master plan – USMID support. • Provision of drainage channels is a priority e.g. on Banyu road

Transport	• Both paved and unpaved roads • Poor state of paved roads – pot holes no drainage network. • Unpaved roads impassable during rains • Under USMID some roads being improved. • Traffic congestion on the increase, inhibiting mobility. • One development objective is to set up a planned, developed and maintained road network that will facilitate development
Housing	• 51,742 (98.9%) households live in dwelling units constructed using permanent roof materials, 75.9 permanent wall material, 74.7% permanent floor material, 29.3 % semi-permanent dwelling units and 1.1% temporary and 89.8% do not live in decent dwellings
3. Governance	
Planning	• Structure Plan 2005-2018 - new Physical Development underway • 5-year Development Plan 2015/16 – 2019/20 • Municipal Development Strategy 2016-2040 – USMID support • Solid Waste Management strategy – USMID support • Drainage Master Plan – USMID support • Environmental Action Plan 2016/17 – 2020/21
Willingness of urban authorities (leadership) to address climate change	• Green economy being encouraged - economic growth, renewable energy (solar in peri-urban areas) • Efforts to buffer wetlands and promote water catchment manage
4. Socio-economic characteristics	
Population/demographics	• Population 53,710.653, (53,710.653 male and 53,710.653 female), • Annual growth rate 4.5%, • 42.06% below 18 years, (5 year Development Plan)
Population density	• 441persons per sq.km
Urban poverty	• High prevalence of poverty and unemployment. • Main economic activity: employment, business/commerce – wholesale and retails/markets, industry (processing, construction and metal fabrications, farming, hotels, transport • Tourism features a lot in Municipality plans
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Wetland degradation due to encroachment • Drying up of River Rwizi • Disappearance of green belts – turned into commercial plots • Water shortage • DRM/MWE promoting water catchment management – the River Rwizi water catchment protection • DRM/MMC – protection upper catchments, protection of buffers (100m by 100m) mark stones on the river banks) but there is a lot of resistance from communities
Natural assets	• Two rainy seasons • Fertile soils

	• Tourism potential - Ankole cultural sites (tombs of early kings (Abagabe) at Nkokonjeru), water falls on River Rwizi, historical church at Kamukuzi, beautiful environment, farming practices in the rural area, Lake Mburo National Park located 60 km away from town centre that offers game viewing, camping, boat rides, scenic viewing, game hunting, spot fishing and bird viewing.
Climate change response priorities	• Development of a stand alone climate change plan/strategy • River Rwizi catchment protection • Ecosystem restoration and management • Water security/storage – rain water harvesting • Sustainable energy/green energy, energy security • Green tourism • Urban agriculture

7.2.17 Moroto Municipality



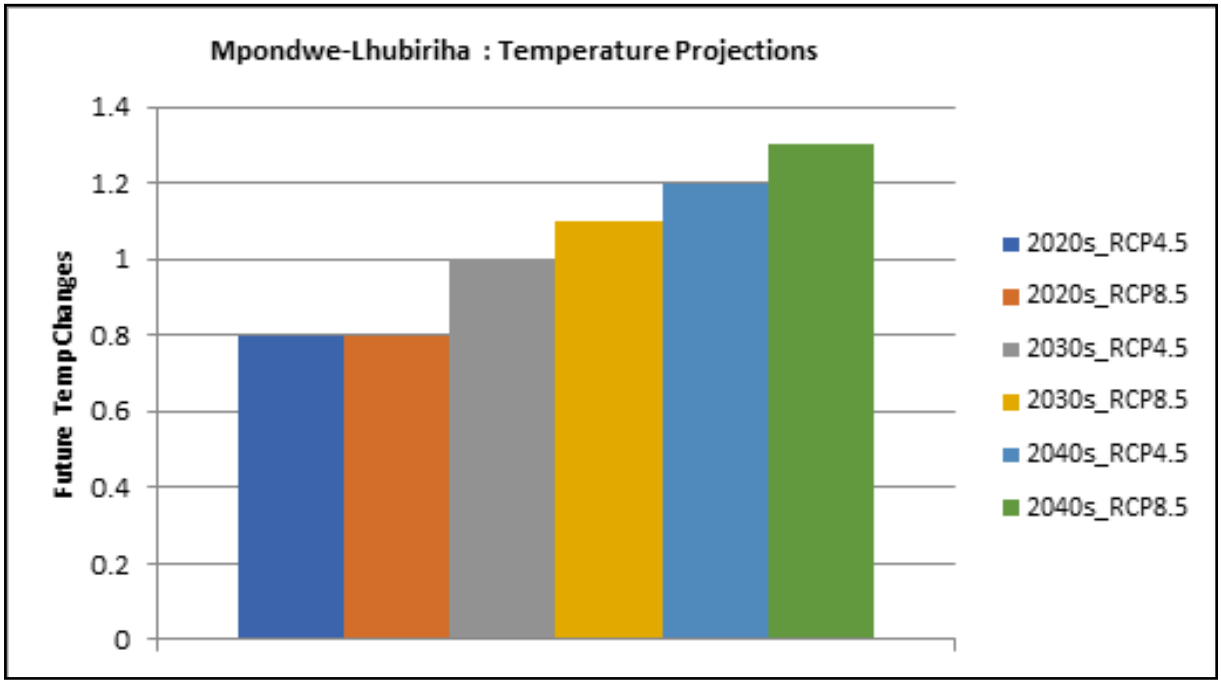


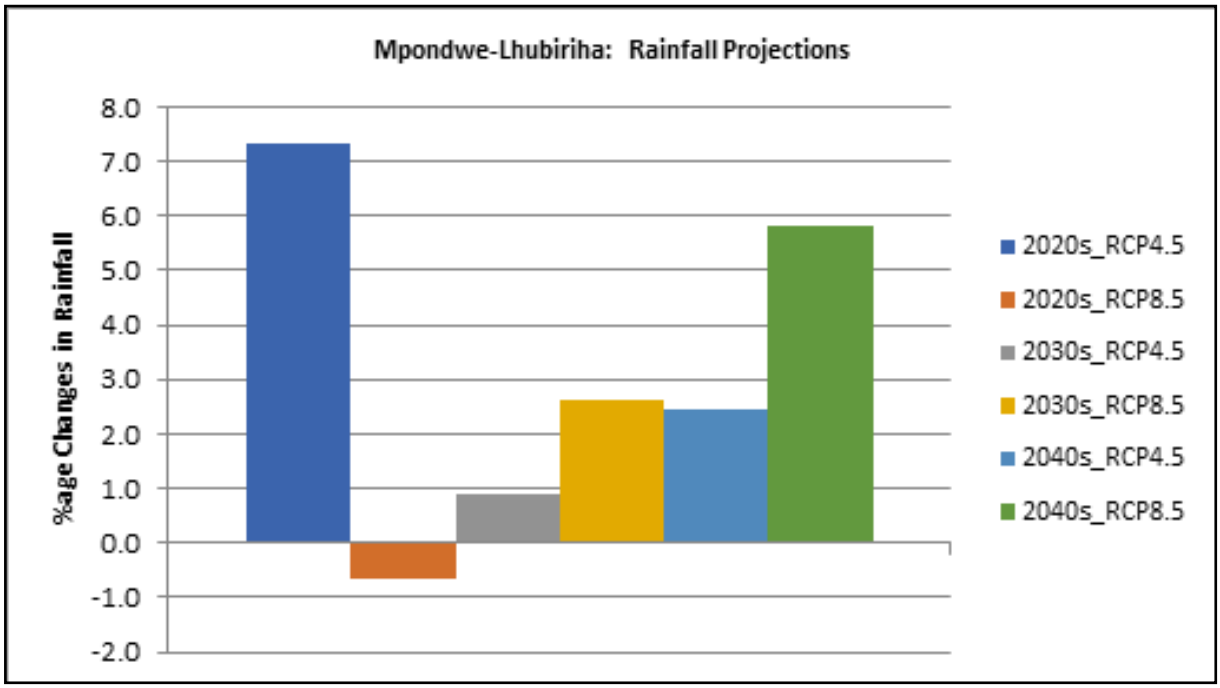
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 23^{0}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.2^{0}C under RCP 4.5 and 1.5^{0}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 875mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -1.0 under RCP 4.5 and -4.3 under RCP 8.5 scenario

Extreme weather events	• Moroto is semi-arid region • Extreme temperatures and heat waves • Prolonged droughts and dry spells: affects copping and livestock, food insecurity • Unreliable rainfall seasons, changing patterns • Extreme rainfall events – • Occasional floods and the bridges overflow and drainage is blocked eg Katonga bridge and Kasmire Primary School bridges • Drought also affects water supply – reduced water table • Strong winds are experienced - house roofs are blown off e.g. Campswahili settlement
Exposure to other hazards	Strong winds, floods food insecurity
2. Infrastructure	
Water supply	• Water stress and water security are serious challenges • 861 (22.9%) households have access to piped water while 75.1% use boreholes (2014 census) • Hand and solar powered boreholes e.g. at Kakoliye Muslim Primary School • Long queues and crowding at the water sources - insufficient pressure, distant water sources, high cost of water, erratic water supply and system break down (Municipal Development Plan pp 24) • Rain water harvesting is on the increase especially with institutions - Kakoliye Muslim Primary School, Leslona Hotel with big underground tank and some households at a small scale • River water is also used by some residents
Energy/electricity	• 1,557 (41.5%) access to electricity for lighting while 5.9% use kerosene/tadooba • Electricity covers over 80% and supply is reliable but is generally used for lighting • Street lighting on some streets like Dodoth road, Lia Street, Lorika road and Narowosi is by hydroelectric power • Wide use of solar in institutions like the Municipal building, schools, hotels as well as individual households • Firewood and charcoal - widely used for cooking • The use of LPG and biogas for cooking is limited
Sanitation and sewerage	• No central sewer system in Moroto Municipality • Septic tanks are used - individuals find places to discharge the faecal matter when septic tanks are full - health hazard • Pit latrines mainly used • 1,118 (29.8%) households did not have sanitation facility (2014 census) • Hepatitis E, diarrhoea occasional dysentery occur - last two years, cases of cholera outbreaks were reported
Solid waste management	• About 20 tonnes of waste is generated per day – only 25% is collected daily due to budget, equipment and other logistical shortcomings • Disposal is in Acholin dumpsite outside the municipality • Un collected wastes is indiscriminately dumped
Storm water drainage	• Extreme rains and floods wash away bridges e.g. Katonga bridge and Kasmire Primary School bridge - a children and one old person lost lives due to overflow 2016, a soldier also drowned • Apart from a few tarmac roads like Lia street, Independence Avenue, and Kitale, drainage is a problem on other roads • Drainage Master Plan – USMID support, but no funds to implement it

Transport	• Moroto Municipality has about 24 km of roads – only 9 km paved • Bus park development – USMID support
Housing	• 3,565 (95.0%) households live in dwelling units constructed using permanent roof materials, 42.2% permanent wall material 52.8% permanent floor material, 54.8 % semi-permanent dwelling units, 4.4% temporary and 92.9 % do not live in decent dwelling
3. Governance	
Planning	• 5-year Development Plan 2015/16 – 2019/20 • Structure Plan 2015 - 2025 - USMID support in the review of the plan • Solid Waste Management strategy 2016/17-2020/21 – USMID support • Environmental Action plan has expired • Drainage Master Plan – USMID support - not yet implemented
Financing	• Budgeting is not sensitive to climate change issues, • Environment and natural resources have a small allocation yet it is critical in mainstreaming climate change concerns. This year it did not receive any funding • Uganda Road Fund in a way considers climate change by having provisions of greening in road construction projects
Participation	• WEITHUNGER supported the Municipality in rehabilitation and construction of bridges like Katonga, Nakapelimen link bridge, prisons bridge and Narowosi bridge which was later reconstructed by the Chinese • ISP (ESIEMESIPOU-Italia) supported Kakoliye Muslim Primary School in establishing solar energy for lighting, ground water pumping, energy saving stoves and kitchen
4. Socio-economic characteristics	
Population/demographics	• Population 14,213, (7,487 male and 6,726 male) • 48.2% is below 18 years meaning high dependency burden (2014 census) • High growth population is expected to double by 2025 (5 year Development Plan)
Population density	No data
Urban poverty	• Very high poverty, unemployment and food insecurity • Retail shops • Kitchen gardens to supplement diets • An predictable rain patterns and drought – affecting livelihoods
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Encroachment on seasonal streams • Encroachment on green belts
Natural assets	
Climate change response priorities	• Develop a stand lone climate change strategy • Climate proofed road infrastructure • Flood management • Water security, water harvesting • Tree plating, greening town • Sustainable solid waste management • Energy security/green energy solutions

7.2.18 Mpondwe-Lhubiriha Town Council



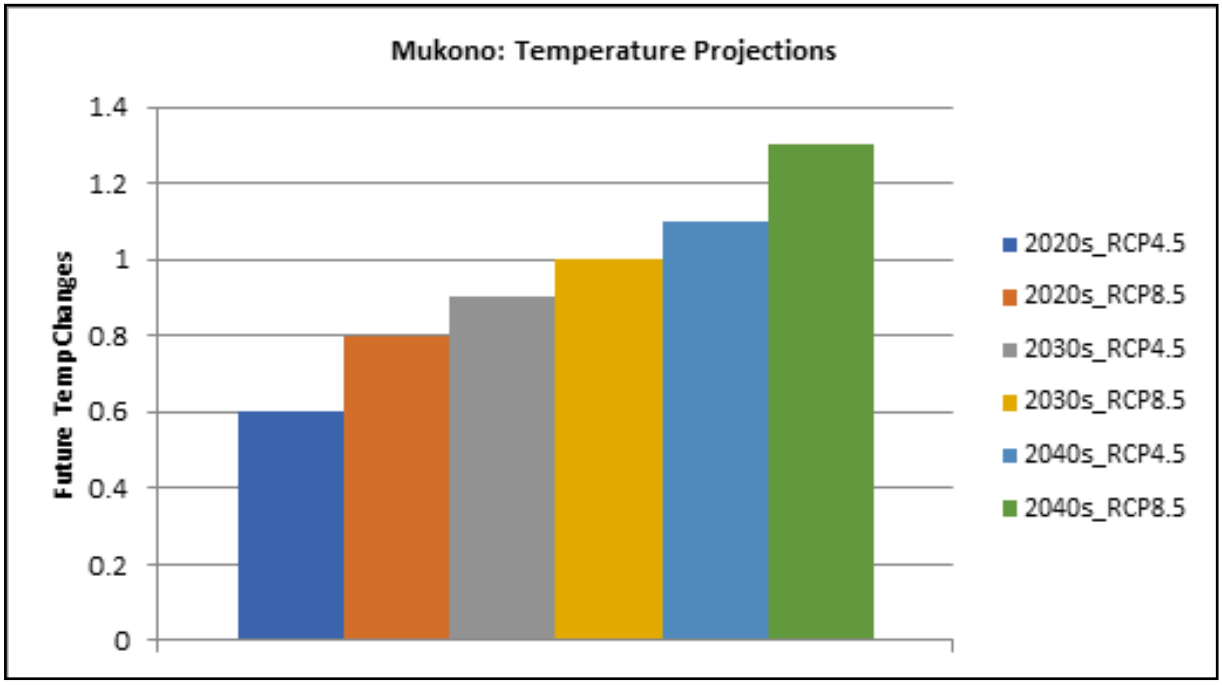


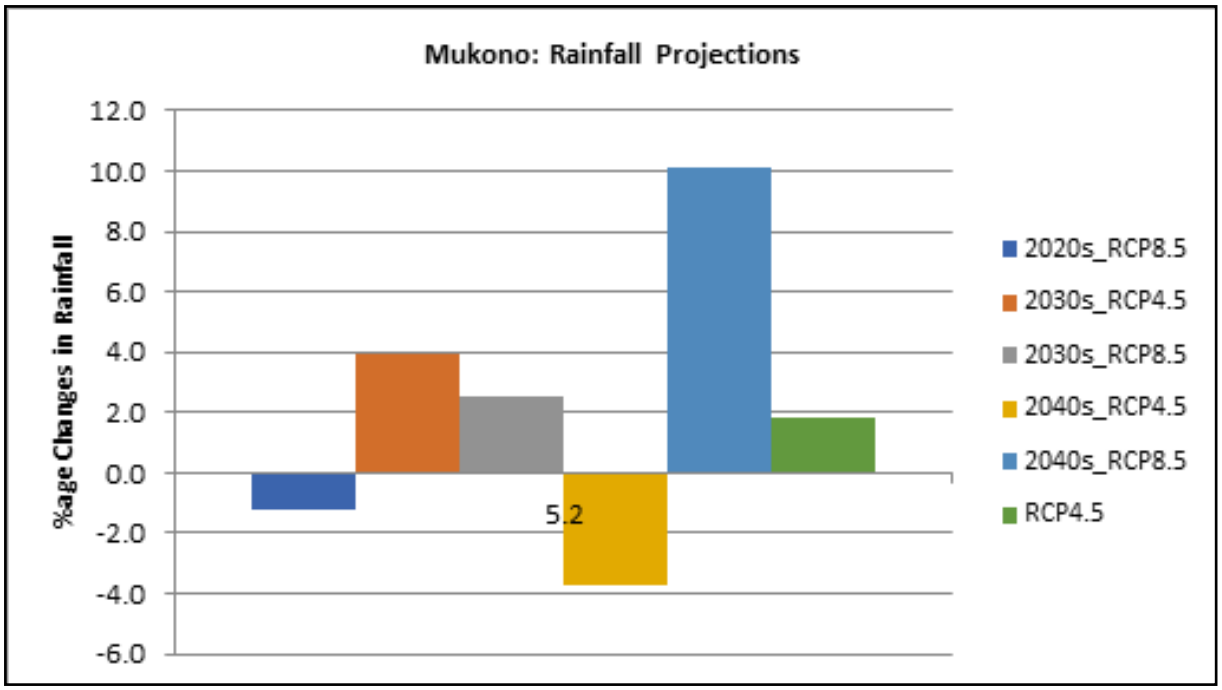
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 23^{0}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.2^{0}C under RCP 4.5 and 1.3^{0}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 969
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by +2.4% under RCP 4.5 and +5.8% under RCP 8.5 scenario

Extreme weather events	• Extreme rainfall events • Unpredictable rain seasons • Floods: e.g. in Kaserengethe and Kyabolokya • Prolonged drought - crop harvests have failed and trees have dried limiting greening and beautification efforts
2. Infrastructure	
Water supply	• Clean water coverage - about 60% coverage (5-year development plan). • Piped water supplied by NWCS but affordability is problem • The Bwera gravity flow scheme is very old with asbestos pipelines. They are rusted and present a health danger • Dirty river water is also used by both humans and animals – health risk • Boreholes are used - although some have dried up due to drought • Protected springs are also used, but drying is a problem.
Energy/electricity	• Connected to national grid, electricity is used for lighting • Charcoal and fired mostly used for cooking • Very few use biogas, LPG and electricity for cooking • Some individuals and institutions like Kasanga Primary Health Centre and Kasanga Catholic Parish have installed solar panels for lighting
Sanitation and sewerage	• No central sewer system • Pit latrines mostly used (75%) • Septic tanks are also used • The hospital has a sewerage lagoon • Water borne diseases like typhoid are common in the TC.
Solid waste management	• Waste management is a big challenge • Waste collection crew transports the waste to Katholhu dumping site along Bwera – Kasese highway • Opening burning of waste at dumping site to reduce volume – this is a health risk • Waste disposal at household level (back yard) is also encouraged by the council - where household have big land
Storm water drainage	• Poor drainage systems • Road surface washed away and gullies develop
Transport	• Mainly unpaved roads. Apart from the main road from Bwera to Customs, all other roads are unpaved/earthen • Many roads on the structure plan not yet opened – limited funding for compensation and opening of roads
Housing	No data
3. Governance	
Planning	• Structure Plan 2012 -2022. Developments are approved by the Technical Planning Committee taking care of roads including those not yet opened • Has a 5-year development plan is in place. However, implementation is a challenge due to little funding
Financing	• Budget is sensitive to climate change - tree planting initiatives
Participation	• RWECO which is a Rwenzori consortium is in involved in tree planting and sensitization on climate change related issues – other partners include Lions Club International, NWSC and Centenary Bank which recently supplied 96 tree seedlings to the town council

Willingness of urban authorities (leadership) to address climate change	• Nursery beds are in place to supply trees to the community at no cost to encourage them plant trees for instance a long Katoro – Customs road • The trees are aimed to provide street shades and beautification – due to prolonged drought, trees end up drying. • Sensitization and promotion of rainwater harvesting is being undertaken – curb long droughts and high water bills
4. Socio-economic characteristics	
Population/demographics	• Population 51,018 (census, 2014) • Annual population growth is 3.5% • 9,664 households
Population density	No data
Urban poverty	• Cross border trade with DRC – fish, timber and genral merchandise • Agriculture is main economic activity. • Unemployment and underemployment
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Ecosystem degradation through sand mining, brick making and quarrying (aggregate stone extraction) along Mpondwe and Lhubiriha rivers • Abattoir discharges waste and blood into the rivers • Encroachment on river banks by agriculture and eucalyptus plantations • Deforestation driven by charcoal production, timber, and bricklaying • Degraded Ihandiro upstream where all trees have been cut and the rivers where sand mining and bricks are made
Natural assets	
Climate change response priorities	• Water catchment protection, protection of river banks • Ecosystem restoration and management • Flood management • Energy security, renewables and improved cook stoves • Water security and water management – water harvesting and storage • Climate proof physical planning and development • Climate resilient transport infrastructure.

7.2.19 Mukono Municipality



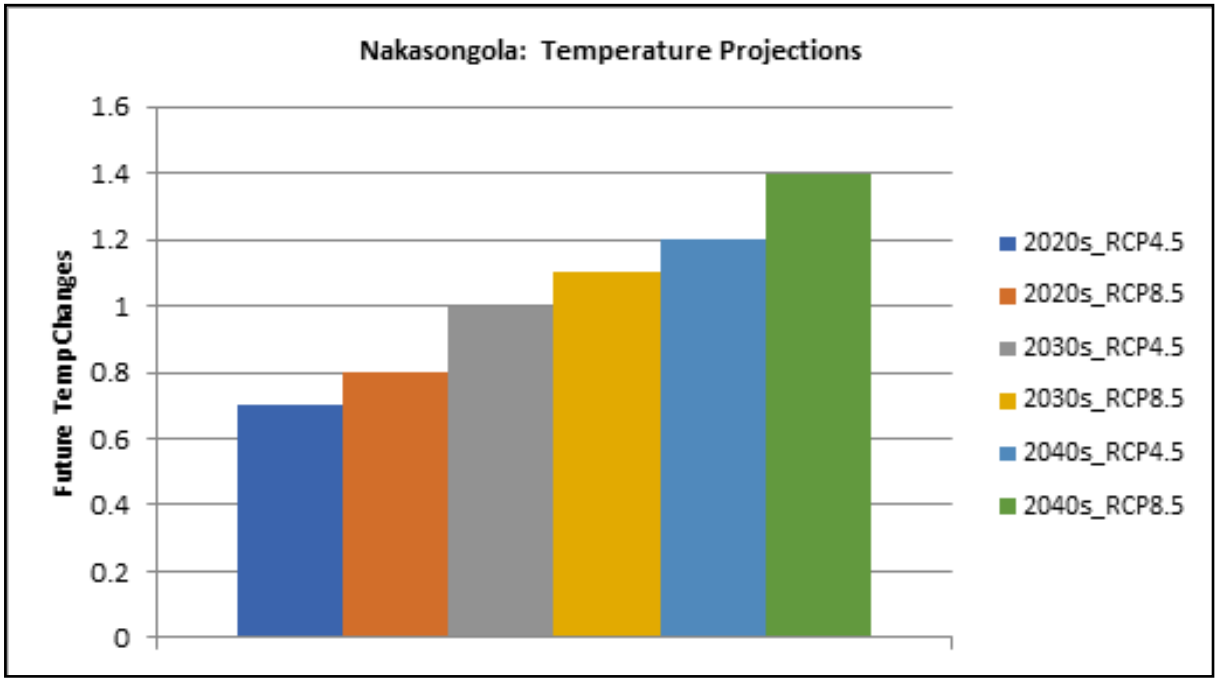


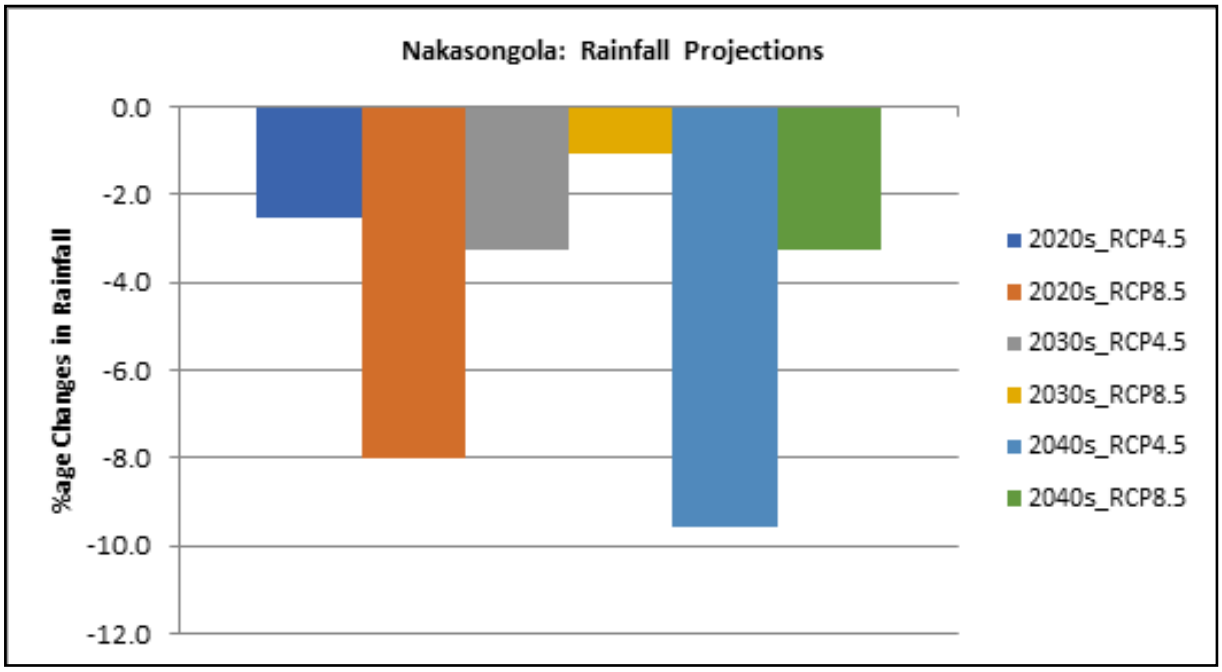
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 22^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.1^{o}C under RCP 4.5 and by 1.3^{o}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1,390mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -3.8% under RCP 4.5 and +10.1% under RCP 8.5 scenario

Extreme weather events	• Extreme temperatures and heat waves • Changing rainfall seasons/patterns • Droughts • Extreme rainfall • Floods e.g. opposite Centenary bank, lower park taxi area and the market
Exposure to other hazards	High land/ecosystem degradation
2. Infrastructure	
Water supply	• Piped water supply by NWSC • 22,952 (59.8%) households had access to piped water while 7.3% used boreholes • Wells also used
Energy/electricity	• 26,110 (68%) of the households used electricity for lighting while 10.8% used kerosene/tadooba • Charcoal for cooking and firewood are used for cooking
Sanitation and sewerage	• Septic and pit latrines widely used • When it rains, people realise faecal matter from septic and pit latrines • 65 (0.2%) of the households did not have sanitation facility (2014 Census.
Solid waste management	• Has a CDM solid waste composting facility at Katikolo • Very old tractor used in transporting solid waste • Common practice to throw garbage in the drains
Storm water drainage	• No drainage plan • Flooding in some places like the market area
Transport	• 350 km of road of which only 10km paved by Municipality, 20 km paved under UNRA • Informal trading along drainage channels makes maintenance works difficult.
Housing	• 38,338 (99.8%) of the households live in dwelling units constructed using permanent roof materials, 97.8% permanent wall material, 93.2% permanent floor material, 7.8% semi-permanent dwelling units, 0.1% temporary. • Slum settlements in Kikoza, Kitete and parts of Seta. • Housing, proper sanitation and garbage increase are still are a major burden that need long term strategy (5 year Development Plan) • One environmental action that can reduce poverty is increasing access to less crowded, better quality housing— through supporting low income groups to build, develop or buy less crowded, better quality housing (5 year Development Plan)
3. Governance	
Planning	• Initial Physical Development Plan was covering the old Mukono Town Council – • Got Municipal status in 2010 and now in the process of preparing a Municipal Physical Development Plan • 5 year Development Plan 2016/16 – 2019/20
Financing	• Environment and climate change not well mainstreamed - some resources are allotted for tree planting. • Schools Facilities Grants (SFG) require environmental auditing and screening of projects
4. Socio-economic characteristics	
Population/demographics	• Population 162,744 (78,466 male 84,276 female), • 48% is below 18 years meaning high dependency burden (2014 census).
Population density	775 persons/sq.km

Urban poverty/economy	Urban poverty and unemployment are serious challenges especially among the youth and in informal settlements. Main economic activities: stone quarrying, brick laying, boda-boda cycling, petty food vending, trading, hotels, lodges and restaurants, construction, small scale agriculture and public service among others.
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Encroachment on wetlands and forests affects natural water flow. • Degazettement of Namanve forest reserve
Natural assets	• Wetlands in Namanve, Nakalere, Nakawolole and Lweza Forest Reserves in Namanve and Nakagere • Stone quarrying in Kirangira,Nakagere and Katikolo, Lwajali stream • Lake Victoria
Climate change response priorities	• Developing a standalone climate change strategy/plan; efforts under way in collaboration with KCCA through EU project support. • Climate proofing Municipal Physical Development Plan and overall physical planning process. • Flood management – development and implementation of a municipal drainage master plan • Slum upgrading (Kikoza, Kitete and Seta) taking into account a changing climate • Sustainable/green energy – energy access and security; improved cook stoves. • Water security and management – rainwater harvesting • Urban agriculture • Green tourism development

7.2.20 Nakasongola Town Council



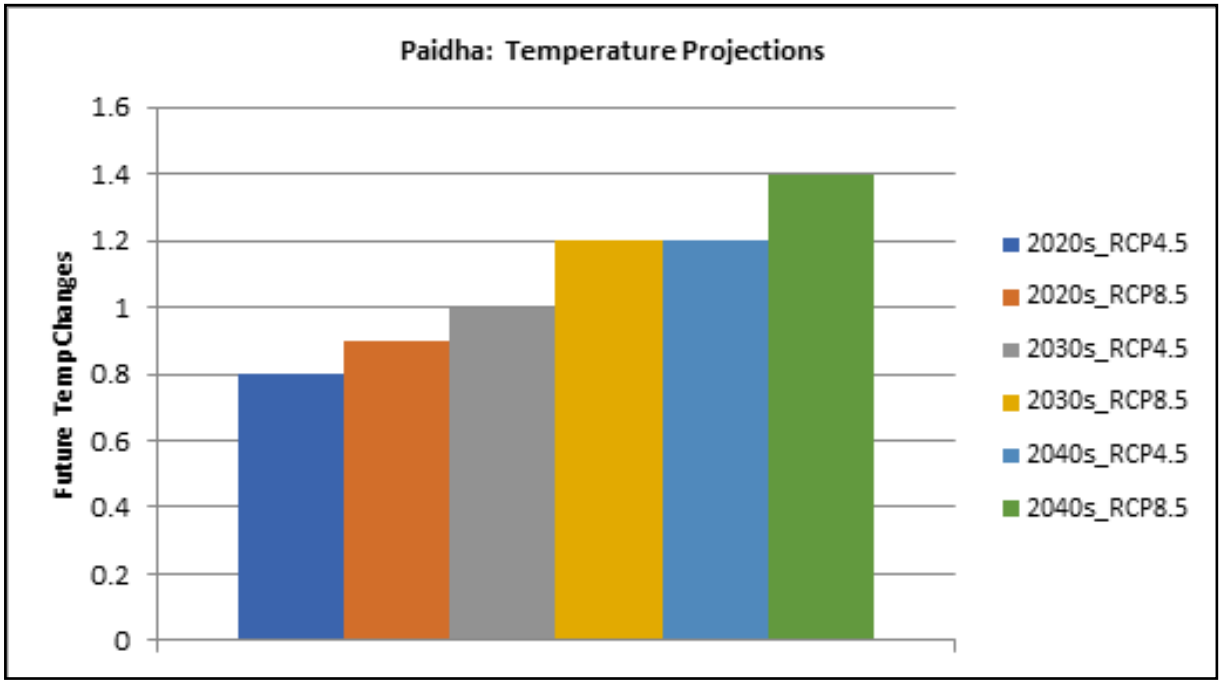


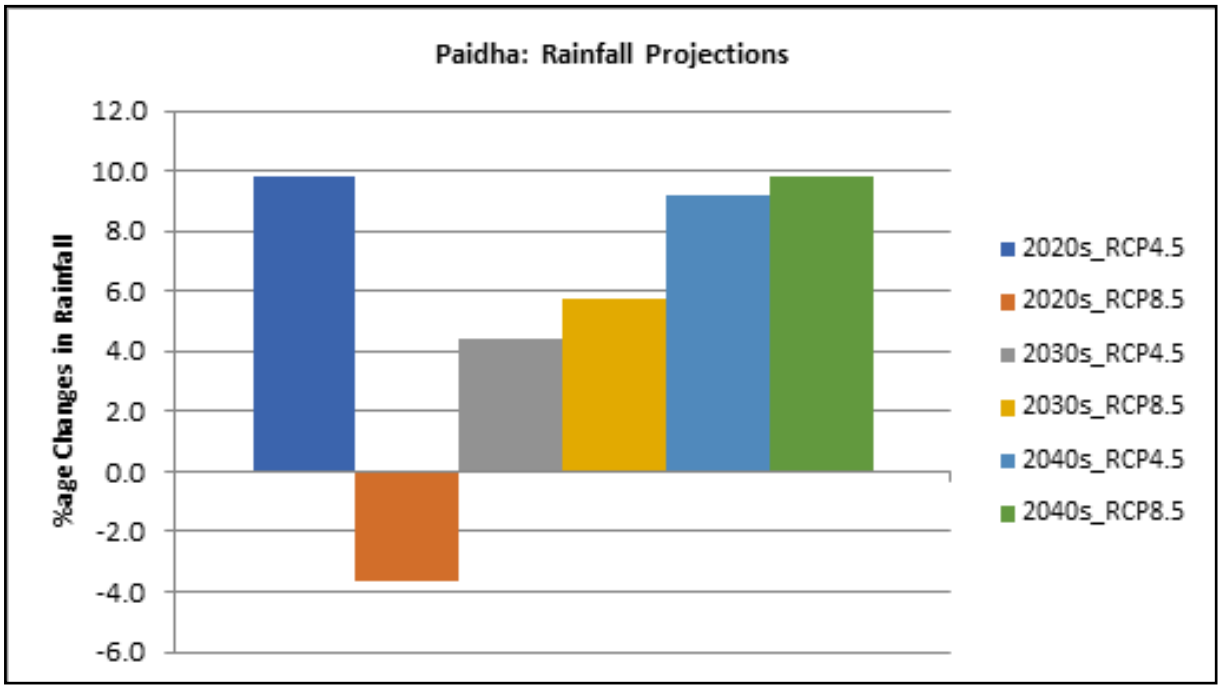
Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 22.8^{0}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.2^{0}C under RCP 4.5 and 1.4^{0}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1,058mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by -9.6% under RCP 4.5 and -3.3% under RCP 8.5 scenario

Extreme weather events	• Located in Uganda's cattle corridor – semi arid area • Extreme temperatures and heat waves: Jan to March and October to December. • Droughts and long dry spells and droughts – becoming severe • Unreliable rainfall patterns- water availability and food production, and beautification of the town i.e. trees and flowers dry up
2. Infrastructure	
Water supply	• Piped water supplied by NWSC. Source is Lake Kioga • Piped water coverage- 60% of the town – water is reliable but expensive i.e. connections and tariffs • Boreholes supply about 30% of the population – poorly maintained and yield is reducing due to reducing water table (droughts) • Valley dams also supply water to human and animals – not clean for human consumption, but also dry up in dry periods.
Energy/electricity	• Connected to national grid – electricity coverage is only 30% of population • Electricity is used for lighting, • Solar used by a few households and institutions • Kerosene widely used for lighting • Charcoal and firewood used for cooking • Energy cooking stoves used by very few. • District supplies charcoal to Kampala – deforestation • LPG used by very few • Generators are used by businesses when electricity is off. • Solar street lighting – being installed only three in the whole town – funding is the limitation
Sanitation and sewerage	• Pit latrines widely used • Septic tanks also used
Solid waste management	• Collection and disposal at the Kiwongale dumping site • Collection is about 80% coverage, public waste collection • Complaints of communities around the dumpsite • No solid waste management strategy/plan • No recycling or composting • Some people sort waste
Storm water drainage	• Drainage is a big challenge • No drainage plan
Transport	• Road network is 57.3km: UNRA 15 km (paved) and Town Council 42.3 km (unpaved) • Unpaved roads are washed away by rains and storms
Housing	No data
3. Governance	
Planning	• 5-year development plan 2015/16 – 2019/20 • Physical Development Plan is being prepared 2018 – 2028
Financing	• Climate change not mainstreamed in budget – but tree planting every financial year is budgeted for
Willingness of urban authorities (leadership) to address climate change	• Tree planting – sensitization on-going in Town Council and District
4. Socio-economic characteristics	
Population/demographics	Population 10,289, (2014 census)
Population density	No data

Urban economy/poverty	• Agriculture is the main activity – cropping and animal rearing • Main crops grown – maize, cassava and potatoes • Food dependant – food from Luwero and Masindi – high food process • Animals mainly cattle - pastoralists and agro-pastoralists • Long droughts threaten food security and incomes
Per Capita GDP	No data
5. Environment and ecosystems	• Deforestation driven by charcoal burning and farming • Challenge of termites which destroy vegetation • Widespread bush burning • Encroachment on wetlands
Natural assets	• Forests and Wetlands • Lake Kyoga
Climate change response priorities	• Addressing water security – water harvesting and storage, • Water for production/irrigation (solar powered), and urban agriculture • Sustainable/green energy; energy security and access – solar and biogas • Ecosystem management and restoration • Solid waste management (greening practices)

7.2.21 Paidha Town Council





Variable	Description
1. Natural hazards	
Temperature – observed trends (1975-2005)	• Annual mean 22.7^{o}C
Temperature-projected change by 2040	• The annual temperature will increase by 1.2^{o}C under RCP 4.5 and 1.4^{o}C under RCP 8.5 scenario
Rainfall – observed trends (1975 – 2005)	• Annual mean 1,370mm
Rainfall – projected by 2040	• A deviation in annual precipitation from the normal by +9.2% under RCP 4.5 and +9.8% under RCP 8.5 scenario

Extreme weather events	• Extreme temperature and heat waves • Unpredictable rain seasons – no longer March to June, August to October as it used to be • Increased cases of droughts - since 2015 - valleys dried out and the water level in River Nyagak reduced affecting power generation source at Nyagaka power station that supplies electricity to West Nile region • Floods - Ovuruyindi village is mainly affected
2. Infrastructure	
Water supply	• Piped water supplied by NWSC, limited to high connection costs and high tariffs • There are communal stand points for those who cannot afford house connection • Boreholes and protected wells are source of water in the outskirts of the town • Rainwater harvesting is not a common practice in Paidha
Energy/electricity	• Paidha has electricity supply, mainly used for lighting • Electricity is generated from Nyagak power station – used for lighting • Very unreliable electricity supply – load shedding and power outages are frequent. • During the dry season water levels go low – limited/no power generation • Use of solar energy by many households and institutions • Charcoal and firewood are used for cooking - women have to move long distances in search for firewood or use grass for cooking
Sanitation and sewerage	• No central sewer system • Pit latrines are largely used • Ecosan toilets have been constructed at community level and in some schools by NWSC - Oturgang and Nguthe Primary Schools, Akir, Aringo, Arutha villages and Jupanyondo West • Few individuals and hotels use septic tanks.
Solid waste management	• Solid waste management is a big challenge • About 10 tonnes of wastes are collected daily, far less than what is generated • Mobile waste collection system is dominant, • Waste collection vehicles breakdown is a big challenge in ensuring daily collection • Waste generation is more during the maize and rain season, Wednesday and Saturday due to a regional market that attracts people from DRC, Gulu and beyond. • Littering is evident in the town - uncollected garbage end up in the blocking drainage channels
Storm water drainage	• Drainage is in poor condition. The council has put in a place a budget in each financial year to try and improve the drainage systems • Solid waste is dumped in the drainage channels
Transport	• 45 km of road of which only 4.3Km is paved • Road surfaces have been swept away due to poor drainage systems
Housing	No data
3. Governance	
Planning	• Structure Plan 2014-2024 • 5 year Development Plan exists
Financing	• Climate change related issues are considered - tree planting in the valleys catchments and roads

Participation	• Life Concern is a human rights organization championing climate change issues in Paidha - engage in organizing and sensitizing women and the youth on saving, sensitization on climate change, promotion of energy saving cook stoves. • Ministry of Health through the sanitation fund, sensitizes people on sanitation issues at village level using the village health teams • NFA is encouraging people to grow trees - supply seedling and the land where the trees are to be grown for instance Paidha Sub County a border to Nebbi in a place called Kalwang
Willingness of urban authorities (leadership) to address climate change	• Development regulations, households must have beautification by tree and flower planting in there building plans to act as wind breaks and scenery • Petrol stations, storeyed buildings and other massive developments are required to carry out EIA before development permits are granted • By-law stopping grasshopper trapping to save other insects necessary in ecosystem services
4. Socio-economic characteristics	
Population/demographics	• Population 28,555, (13,807 males and 14,748 females), • 54.6% is aged 0-18 years – high dependence burden. (5 year Development Plan)
Population density	• 984 persons/sq.km
Urban poverty/economy	• Agriculture is a main activity but drought threatens people's livelihoods • Food crops like maize, cowpeas and fruits as well as coffee are a source of income for many • It is a order town, and the economy is largely based on business
Per Capita GDP	No data
5. Environment and ecosystems	
Ecosystems	• Charcoal burning - Lendu and Usil forests have disappeared due to increased charcoal burning. This could increase GHG emissions • Green belt was gazetted in the structure plan - council has never acquired the land from the individual owners due to limited funds for compensation • Encroached on the natural drainage systems for crop growing like potatoes and vegetables • Grasshopper trapping practice - insects that support ecosystem services end up trapped and die in the process
Natural assets	• Rivers Nyagak and Nyibola • Wetlands • Favourable climate and soils for agriculture
Climate change response priorities	• Solid waste management: green practices like composting are preferred • Drainage improvement and flood management • Sustainable energy/green energy solutions; energy security; improved cook stoves • Water catchment protection, ecosystems management and tree planting

7.3 Annex 3: Stakeholders Consulted

No.	Names	Sex	Title	Organization	E-mail contact	Tel. Contact
1	Mr. Onesimus Muhwezi	Male	Team Leader - Environment, Climate and Disaster Resilience	UNDP Uganda	onesimus.muhwezi@undp.org	0772 289139
2	Ms. Sarah Mujabi	Female	Programme Officer, Climate Change	UNDP Uganda	sarah.mujabi@undp.org	0772 289138
3	Mr. Steven Goldfinch	Male	Disaster Risk Management Advisor	UNDP Uganda/OPM	Steven.Goldfinch@undp.org	0772 289175
4	Ms. Rebecca N. Sserwanga	Female	Learning and Knowledge Management Specialist	UNDP Uganda/OPM		0774 006060
5	Ms. Catherine Ahimbisibwe	Female	Principal Disaster Management Officer	OPM	ahimbika@yahoo.com	0772 565109/0703 405619
6	Mr. Alfred Ongom	Male	Systems Administrator	OPM	awioopadul@gmail.com	0772 289209
7	Mr. Aron Werikhe	Male	Planner Environment and Natural Resources	National Planning Authority	aronwerikhe@gmail.com	0774 693761/0704 149665
8	Mr. Denis Kidega	Male	Senior Physical Planner	MoLHUD	kidegad@gmail.com	0776 847844
9	Mr. Joseph Walter Pade	Male	Commissioner, Urban Development	MoLHUD	walterpade@gmail.com	0776 608758
10	Mr. Wilson Awuzu	Male	Principal Economist, Planning Department	MoLHUD	awuzuwilson1@gmail.com	0772 613602/0757 769392
11	Mr. Jotham Muyambi Gumisiriza	Male	Senior Urban Officer, Department of LURC	MoLHUD	jmuyambi2014@gmail.com	0772 333843
12	Mr. Richard Anguzu Erima	Male	Principal Urban Development Officer, Department of LURC	MoLHUD	angrima2014@gmail.com	0772 559664/0753 559664
13	Mr. J. Sibuyira	Male	Ag. Commissioner Landuse Regulation and Compliance (LURC)	MoLHUD	sibuyira@gmail.com	
14	Ms. Maria Nanteza	Female	Geographer, Department of Physical Planning	MoLHUD	maria.nanteza@gmail.com	
15	Mr. Henry Ogen Opio	Male	Principal Land Management Officer	MoLHUD	opiogenyi59@gmail.com	
16	Mr. Samuel Mabala	Male	Commissioner, Human Settlements	MoLHUD	samuel.mabala@gmail.com	
17	Mr. Henry Muhairwe	Male	Senior Physical Planner - LURC	MoLHUD	rutekanga@gmail.com	0772 185684
18	Mr. Arthur Abigaba	Male	Urban Development Officer	MoLHUD		0751 600880
19	Mr. Steven Olowo	Male	Urban Officer	MoLHUD	steolo85@yahoo.com	
20	Ms. Rosemary M. Mukite	Female	Ag. Commissioner Urban Development	MoLHUD	mukiterosemary@yahoo.com	
21	Mr. James Kagwisa	Male	Senior Physical Planner; Department of Physical Planning	MoLHUD	kagwisaf@gmail.com	
22	Ms. Faridah Namukasa	Female	Urban Development Officer	MoLHUD		0758 170082

No.	Names	Sex	Title	Organization	E-mail contact	Tel. Contact
23	Ms. Doreen Kembabazi	Female	Housing Officer	MoLHUD		0700 776245
24	Mr. Stephen M. Bogere	Male	Senior Sociologist	MoLHUD	smbogere@gmail.com	0702 824048
25	Ms. Olive Nalugo	Female	Civil Engineer	MoLHUD	noliovy@yahoo.com	
26	Mr. Denin N.K	Male	Economist	MoLHUD	devinemki@gmail.com	
27	Ms. Fridah Mutuzo	Female	Ag. Assistant Commissioner - LURC	MoLHUD	mutuzofridah@yahoo.com	0772 319375
28	Mr. David Kasimbazi	Male	Senior Urban Officer	MoLHUD	kasimbazi.david@gmail.com	0772 621024
29	Mr. Swaib Mutaka	Male	Physical Planner	MoLHUD		0705 718904
30	Mr. Emmanuel Ongora	Male	Senior Physical Planner	National Planning Authority	eongore@npa.ug	
31	Mr. Michael Mugarura	Male	Senior Climate Change Officer	Climate Change Department, MWE	mugarura.michael@gmail.com	
32	Mr. Bob Natifu	Male	Senior Climate Change Officer	Climate Change Department, MWE	bob.natifu@gmail.com	
33	Mr. Mohammed Semambo	Male	Senior Climate Change Officer	Climate Change Department, MWE	medi.ssema35@gmail.com	
34	Mr. Vicent Eibu	Male	Principal Planner	Kumi Municipality	eibuv@yahoo.com	
35	Eng. Emmanuel Ngiraba-kunzi	Male	Municipal Engineer	Kabale Municipality	ngira.emmy@gmail.com	0772 413221
36	Ms. Sharon Auma	Female	Physical Planner	Kabale Municipality	shauma85@gmail.com	0777 046969
37	Mr. Alfred Ahimbisibwe	Male	Environment Officer	Kabale Municipality	alfredhimbis@gmail.com	0772 328451
38	Mr. Wilberforce Korugyendo	Male	Senior Planner	Kabale Municipality	korugyendowilber@gmail.com	0772 880125
39	Ms. Carol Warugaba	Female	Physical Planner	Mbarara Municipality	warugabacarol@yahoo.com	0703 277450
40	Mr. Patrick Kanamugira	Male	Economic Planner	Mbarara Municipality		0701 592532
41	Mr. Hebert Tumwebaze	Male	Environment Officer	Mbarara Municipality	tuherbert06@gmail.com	0701 842038
42	Ms. Pauline Nabadda	Female	Environment Officer	Masaka Municipality	n.pauline61@yahoo.com	0753 310966/0772 301966
43	Mr. Martin Kigozi	Male	Physical Planner	Masaka Municipality	kigozi44@gmail.com	0700 886879/0774 450226
44	Mr. Pontiano Mayiito	Male	Senior Planner	Masaka Municipality	pmayiito@yahoo.com	0701 697429/0772 697429
45	Mr. Paul Omoko	Male	Town Clerk	Masaka Municipality		0772 673407/0701 673407

No.	Names	Sex	Title	Organization	E-mail contact	Tel. Contact
46	Ms. Juliet Muyonjo	Female	Economic Planner	Entebbe Municipality	julietmuyonjo2013@yahoo.com	0774 128354
47	Ms. Margaret Kadama R.	Female	Physical Planner	Entebbe Municipality	maggiexx2000@yahoo.com	0773 647714
48	Ms. Florence Najjuma	Female	Environment Officer	Entebbe Municipality	fnajjuma@gmail.com	0782 863070
49	Mr. Samson Semakula	Male	Agricultural Officer	Entebbe Municipality	sam.semakula@gmail.com	0772 505652
50	Mr. Charles Mutyabule	Male	Environment Officer	Kamuli Municipality	mutyabulenaluswa@yahoo.com	0772 517747 / 0702 004282
51	Mr. Kaleebi Jacob Nankoza	Male	Senior Physical Planner	Kamuli Municipality	jacobkaleebi@yahoo.co.uk	0772 845514/0704 281226
52	Mr. Thomas Ikanga	Male	Economic Planner	Kamuli Municipality	thomasikanga@yahoo.com	0754 266396/0774 266396
53	Mr. Shedrack Mwalye	Male	Municipal Engineer	Kamuli Municipality	mwalshad@gmail.com	0702 226199/0785 482389
54	Mr. Vicent Paul Kyanja	Male	Mayor/Chairperson	Entebbe Municipality/LVRLAC Uganda Chapter	mayor@entebbe.go.ug, kayanja.vincentdepaul@yahoo.com	0772 489466
55	Mr. Mercy Stephen Sebuliba	Male	Partnership and Research Officer	LVRLAC	theprojectofficer@lvrlac.net, sebulibamercy@yahoo.co.uk	0703 825304
56	Mr. Patrick Emukule	Male	Programme Unit Manager	Plan International - Kamuli	patrick.emukule@plan-international.org	0772 344770
57	Mr. Kanku Francis Koky	Male	Programme Unit Manager	Plan International - Kamuli	francis.kanku@plan-international.org	0392 946312
58	Mr. Charles Nampendho	Male	Physical Planner	Jinja Municipality	nampendho@gmail.com	0704 970383/0784 078301
59	Mr. Francis Byabagambi	Male	Town Clerk	Jinja Municipality	frankbk1@hotmail.com	0785 958821
60	Mr. Muhamad Saeed	Male	Municipal Engineer	Jinja Municipality	muhamad.almuzahim@yahoo.co.uk	0701 488836
61	Mr. Ernest Nabihamba	Male	Environment Officer	Jinja Municipality	enabi65@gmail.com	0702 617396/0776 945046
62	Mr. Mercy Kyangwa	Male	Senior Economic Planner	Jinja Municipality	kyangwa20@yahoo.com	0704 518903
63	Ms. Christine Nafuna	Female	Physical Planner	Malaba Town Council	nafunachristine@gmail.com	0782 372457/0705 437833

No.	Names	Sex	Title	Organization	E-mail contact	Tel. Contact
64	Mr. Moses Opio	Male	Town Engineer	Malaba Town Council	opiowater@gmail.com	0772 646467/0702 631272
65	Ms. Evelyn Aol	Female	Environment Officer	Malaba Town Council		0783 810003/0702 937758
66	Mr. Samuel Oulet	Male	Economic Planner	Malaba Town Council		0787 672711/0778 136530
67	Ms. Rhoda Nyaribi	Female	Environment Officer	Mbale Municipality	nrhoda22@yahoo.co.uk	0772 693722/0703 907260
68	Mr. Fred Nambafu	Male	Physical Planner	Mbale Municipality	fnambafu10@gmail.com	0772 912155
69	Mr. Anthony Wanasolo	Male	Senior Engineering Officer	Mbale Municipality	tonnywanasolo@gmail.com	0774 326506
70	Mr. John Moses Wastomu	Male	Senior Planner	Mbale Municipality		0705 330156/0777 084995
71	Ms. Juliet Nabwire	Female	Physical Planner/Environment Officer	Nakasongola Town Council	nabwirejuliet52@yahoo.com	0772 419068/0700 862112
72	Mr. Emmanuel Sekitende	Male	Assistant Engineering Officer	Nakasongola Town Council	sekitendeemmanuel@gmail.com	0772 975006/0704 775007
73	Mr. Ezra Akampurira	Male	Physical Planner	Kiruhura Town Council	akampuriraezra@gmail.com	0784 372124/0702 699220
74	Mr. Rodgers Tumwebaze	Male	Health Assistant/Environment Focal Person	Kiruhura Town Council	tumwebazerodgers6@gmail.com	0771 819171/0703 479212
75	Mr. Festo Tandeka	Male	Town Clerk	Kiruhura Town Council	andekafesto@gmail.com	0782 408022
76	Mr. Polly Muhwezi	Male	Senior Community Development Officer/Economic Planner	Kiruhura Town Council	asiimacraid@gmail.com	0755 485831
77	Ms. Deborah Namara	Female	District Environment Officer	Kiruhura District LG	debbienamara@yahoo.com	0701 327083/0773 150128
78	Ms. Josephine	Female	Physical Planner	Amudat Town Council	josenambozo@gmail.com, liz_naj@yahoo.com	0754 489976
79	Mr. Charles Loris	Male	Town Clerk	Amudat Town Council	clokoroiokwi@yahoo.com	0782 329617
80	Mr. Aron Lokwang	Male	Environment Officer	Amudat Town Council	lokwang aron@gmail.com	0773 145622
81	Mr. Emmanuel Musau	Male	Agricultural Officer (Sub-County)	Amudat District	musaubarteka@gmail.com	0702 023115/0787 768062
82	Mr. Martin Etolu	Male	Programme Manager	ZOA International - Uganda/Amudat	pgmamudat@zoa.ug	0773 085944

No.	Names	Sex	Title	Organization	E-mail contact	Tel. Contact
83	Mr. Yaap van Vrarebury	Male	Trainee Programme Manager	ZOA International - Uganda/Amudat	traineemudat@zoa.ug	0777 317545
84	Ms. Deborah Ariong	Female	Environment Officer	Amudat District/ Town Council	debigraphie@gmail.com	0782 707272
85	Mr. Jimmy Echulu	Male	District/Town Engineer	Amudat District/ Town Council		0774 409354/0756 409354
86	Mr. Charles Lorot	Male	Economic Planner	Amudat District		0772 666383
87	Mr. Moses Lorika	Male	Deputy Town Clerk	Moroto Municipality	moseslorika@gmail.com	0772 876726/0754 876726
88	Ms. Florence Lomise	Female	Physical Planner	Moroto Municipality	flomise998@gmail.com, flomise@yahoo.com	0772 986711
89	Mr. Felex Nelly Olum	Male	Senior Economic Planner	Moroto Municipality	olumbox@yahoo.com	0772 632172
90	Mr. Robert Kairu	Male	Senior Assistant Engineer	Moroto Municipality	kairurob@gmail.com	0753 800217
91	Mr. Robert Galina Muyaba	Male	Headmaster, Kakoliye Muslim Primary School	Moroto Municipality	bernardmuyaba266@gmail.com	0772 030290
92	Mr. Joseph Monday Bagonza	Male	Town Clerk	Arua Municipality	joe_monday20042000@yahoo.co.uk	0772 604228
93	Mr. Fred Asedri	Male	Environment Officer	Arua Municipality	asedrifred@yahoo.com	0782 666020/0754 666020
94	Mr. Anthony Dradria	Male	Senior Civil Engineer	Arua Municipality	drandriathony@yahoo.com	0782 132910/0752 132910
95	Mr. Marchael Anguyo	Male	Senior Economic Planner	Arua Municipality		0704 653062
96	Mr. Moses Alo Findru	Male	Physical Planner	Arua Municipality	alofindru@gmail.com	0782 323530
97	Mr. Anthony Obedgiu	Male	Physical Planner	Paidha Town Council	anthonyobidgui@yahoo.com	0773 443054/0702 779554
98	Ms. Lydia Nyirach	Female	Volunteer Physical Planner	Paidha Town Council	nyirachlydia@gmail.com	0775 701649
99	Ms. Sarah Adong	Female	Assistant Programme Officer, Resource Mobilization	Life Concern Uganda - Paidha	adongsarah@yahoo.com	0750 807446/0770 712245
100	Ms. Jesca Opoti	Female	Health Officer	Paidha Town Council	opotijesca@gmail.com	0782 4937685
101	Mr. Andrew Upenjuru	Male	Revenue Officer/Planning Desk	Paidha Town Council	aupenjuru@yahoo.com	0772 680604
102	Mr. James Okumu Bedijo	Male	Town Clerk	Paidha Town Council	bedijo.james@yahoo.com	0772 565979/0752 565979
103	Ms. Evelyn Mukonyezi	Female	Physical Planner	Gulu Municipality	mukonyezievelyn@gmail.com	0774 157328
104	Mr. Terence Odonga	Male	Municipal Engineer	Gulu Municipality	odonga.terence@gmail.com	0772 591845
105	Mr. John Charles Luwa	Male	Senior Planner	Gulu Municipality	luwa2005@gmail.com	0772 675929

No.	Names	Sex	Title	Organization	E-mail contact	Tel. Contact
106	Mr. Nadru Richard Anyama	Male	Principal Health Inspector	Gulu Municipality	nyadrurichard@gmail.com	0772 316301
107	Mr. James Ocaka	Male	Environment Officer	Gulu Municipality		0774 151502
108	Mr. Alfred Komakech	Male	Agronomist	PRELNOR Project - Gulu	komakech@gmail.com	0773 435858
109	Mr. Peter Bismark Olanya	Male	Environment and Climate Change Specialist	PRELNOR Project - Gulu	peter.olanya@gmail.com	0784 051102/0703 051102
110	Mr. Richard Okedi	Male	Agribusiness and Partnership Management Specialist	PRELNOR Project - Gulu	richard.okedi@gmail.com	0777 773202/0758 773202
111	Mr. Assy Abirebe	Female	Town Clerk	Lira Municipality	aabirebe@yahoo.com	0772 658215/0701 658215
112	Ms. Sarah Adong	Male	Assistant Engineering Officer	Lira Municipality	adongo2sarah@gmail.com	0782 512128
113	Mr. Ambrose Etura	Male	Assistant Physical Planner	Lira Municipality	eturaambrose@gmail.com	0782 264683
114	Mr. Freddie Owiny	Male	Ag. Municipal Engineer	Lira Municipality	owinyfreddie2007@gmail.com	0772 335587
115	Mr. Denis Okello Ayini	Male	Statistician	Lira Municipality	denisronal@gmail.com	0772 692198
116	Mr. Tom Okello	Male	Security Compositing Site	Lira Municipality		0783 191581
117	Mr. Umar Ahmad Kyobe	Male	Head of Operations - Stove	International Lifeline Fund - Lira Municipality	umar@lifelinefund.org, ahmadkumar@yahoo.com	0752 624990
118	Ms. Consolate Nakyagaba Kiyingi	Female	Manager Risk	Kampala Capital City Authority	ckiyingi@kcca.go.ug	0782 467269/0794 660655
119	Ms. Eleth Nakazzi	Female	Project Manager, Kampala Climate Change Project	Kampala Capital City Authority	enakazzi@kcca.go.ug	0772 193658/0794 660722
120	Ms. Annet Nakazibwe	Female	Risk Management Officer	Kampala Capital City Authority	anakazibwe@kcca.go.ug	0794 660670/0757 194058
121	Ms. Olivia Bahwayo	Female	Municipal Physical Planner	Fort Portal Municipality	bahwayoolivia@gmail.com	0772 400186
122	Mr. Samuel Musana	Male	District Physical Planner	Kabarole District	samuel.musana@yahoo.com	0782 108397
123	Mr. Samson Mawenu	Male	Municipal Planner	Fort Portal Municipality	samaw2@yahoo.com	0782 786256
124	Mr. Hebert Kaihura	Male	Municipal Engineer	Fort Portal Municipality	kaihura2000@gmail.com	0772 602746
125	Ms. Gladys Natugonza	Female	Environment Officer	Fort Portal Municipality	natugladi@yahoo.com, natuglad@gmail.com	0781 987975

No.	Names	Sex	Title	Organization	E-mail contact	Tel. Contact
126	Ms. Harriet Kokugonza	Female	Conservation Manager	Toro Botanical Gardens, Fort Portal Municipality	kokugonzah@gmail.com	0771 448655
127	Mr. Patrick Baguma	Male	Organizational Team Leader	JES, Fort Portal Municipality	jese@jese.org, jpbaguma@jese.org,	0772 492109/0483 425253
128	Mr. Edgar Muganzi	Male	Director	Natural Resource Defence Initiative, Fort Portal Municipality	info@nrdiuganda.org, edgar-muganzi@line.com	0772 395749
129	Ms. Evelyn Mugume	Female	Environment Officer	Kasese Municipality	evelynmugume@gmail.com	0776 880370/0701 880370
130	Mr. Wilfred Baluku	Male	Physical Planner	Kasese Municipality	baluku.wilfred@gmail.com	0782 521517/0701 983119
131	Ms. Allen Kiiza	Female	Statistician/Economic Planner	Kasese Municipality	allenkiiza2000@gmail.com	0785 479349
132	Mr. Apollo Batwine	Male	Municipal Engineer	Kasese Municipality	batwineapollo@yahoo.com	0772 619980
133	Mr. Jonathan Muhindo	Male	Municipal Land Supervisor	Kasese Municipality		0705 093288
134	Ms. Alice Bwambale	Female	Senior Assistant Town Clerk	Kabale Municipality	bwambalealice79@gmail.com	0782 566865/0702 566865
135	Ms. Raphaeline Katusabe	Female	Water Officer	Mpondwe-Lhubiriha Town Council	katusaber@gmail.com	0782 237860
136	Mr. Zaverio Baluku	Male	Environment Officer	Mpondwe-Lhubiriha Town Council	balukuzeveno@gmail.com	0777 526338/0756 724837
137	Ms. Doreen Mawa	Female	Physical Planner	Mpondwe-Lhubiriha Town Council	mawadoreen@yahoo.com	0700 425100
138	Mr. Jimmy Odyek	Male	Director RWECO	Mpondwe-Lhubiriha Town Council	jimodyeke@gmail.com	0772 184582